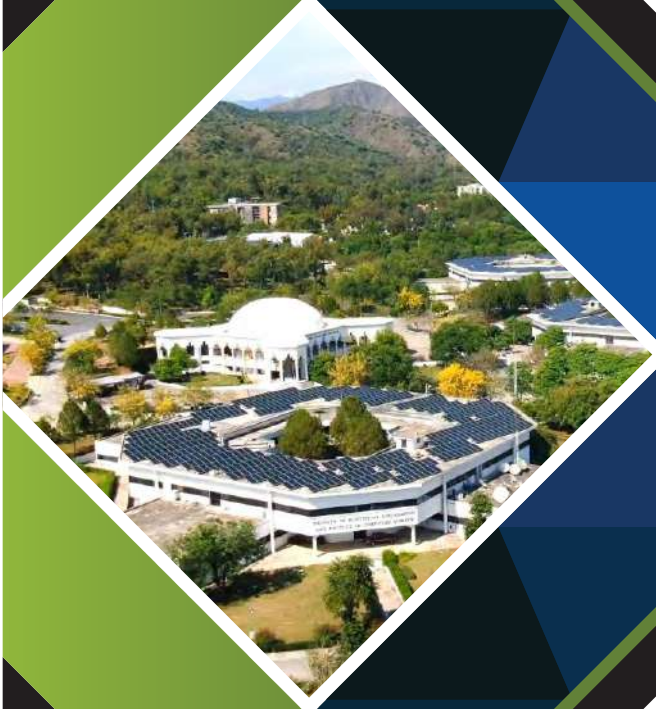
GRADUATE PROSPECTUS 2023



Ghulam Ishaq Khan Institute
of Engineering Sciences and Technology

VISION

The GIK Institute seeks to play an inspiring role in imparting high-quality education and research in the fields of engineering, sciences, emerging technologies and other disciplines.

MISSION

The Institute is to provide excellent teaching and research environment to produce graduates who distinguish themselves by their professional competence, research, entrepreneurship, humanistic outlook, ethical rectitude, pragmatic approach to problem solving, managerial skills and ability to respond to the challenge of socio economic development to serve as the vanguard of techno-industrial transformation of the society

The Founder

"The GIK Institute seeks to play an inspiring role in imparting high-quality education and research in the fields of engineering, sciences, emerging technologies and other disciplines"

Ghulam Ishaq Khan

FROM THE CHANCELLOR

The Ghulam Ishaq Khan (GIK) Institute of Engineering Sciences and Technology has earned a reputation as an institution of the excellence in the country for imparting quality education in engineering sciences and technology. Not many institutions have earned so much recognition and respect, both within the country and abroad, in such a short time as has the GIK Institute. This distinction would not have been possible without the commitment and dedication of its teachers, staff and students. Thus, all of their efforts deserve to be complimented.

Engineering sciences and Technology hold the key to the development and security of the country. Advanced technology, however, is not easily available in the international market nor can it be borrowed. We, therefore, must make a concerted effort to develop our own indigenous technologies that suit our peculiar environment and also caters to our particular needs in the industrial, economic and other sectors.

It is gratifying to note that the private sector is increasingly participating in the effort to broaden the base of scientific and engineering education in the country. I would like to commend the GIK Institute for playing a leading role in this endeavour by introducing new and emerging technologies and producing highly trained manpower capable of meeting the challenges of the modern day, complemented by a robust research program.

Institutes like GIK must play the role of a catalyst in bringing about a techno-industrial transformation. We need men and women of vision, knowledge, courage and integrity. We expect from our institutions to produce such professionals. I urge the GIK Institute to continue its quest for excellence and hope that its alumni serve the nation and contribute towards making Pakistan a highly developed and prosperous country.

May Allah Almighty be our protector and guide! Ameen

Dr. Arif Alvi
President of the Islamic Republic of Pakistan

FROM THE PRESIDENT (SOPREST)

As the President of SOPREST, I am delighted to convey this message to the prospective students and their families.

The Ghulam Ishaq Khan Institute of Engineering Sciences and Technology (GIKI) was founded in 1993 by the late Ghulam Ishaq Khan, former President of Pakistan. In the ensuing three decades the University has grown into a center of excellence in teaching and research in engineering, science, and technology. Today the Institute boasts an alumni body of over 7000, in more than seventy countries, many of whom have excelled in and made lasting contributions to their chosen fields of endeavor.

Despite the challenges faced by our country, I believe that Pakistan has enormous potential, and our young people are a critical part of unlocking that potential. We need to invest in their education and provide them with the tools and knowledge necessary to compete globally. Given the opportunity, Pakistanis can compete with - and beat - the best in the world. GIKI's selective admission process, which emphasizes merit and potential, ensures that the brightest young Pakistani women and men are given the opportunity to learn from our highly qualified faculty and develop the skills and knowledge necessary to drive growth and development in Pakistan.

It goes without saying that the future talent of a country shapes how governments and private organizations/firms are best governed. They derive value from their human capital. In the current economic turmoil, the responsibilities of educational institutions and talented students have assumed significant importance. I would certainly be wishing all the best and expect GIK to empower its talent to become knowledge workers. GIK should provide an enabling environment to students to learn and help organize the activities in a novel way for providing ultimate support to the country.

Change is the only constant in life, and as we move further into the 21st century, we are witnessing huge advancements in technology, particularly in the areas of artificial intelligence (AI) and automation. These technologies have the potential to transform industries and society in ways we cannot even imagine. GIKI is determined to be at the forefront of these developments, with plans for setting up a Center for work on Artificial Intelligence (AI) already at an advanced stage. This comes alongside further additions to our computer sciences programs. In today's digital world where information and knowledge are fast becoming the basis of human economic and social progress, I am glad to see that GIKI is determined to build up its lead as Pakistan's pre-eminent center of excellence in these areas.

The strength of the GIKI "brand" allows it to collaborate with highly ranked universities and corporations around the world through student and faculty exchange programs. As entrepreneurs upend the established corporate world order, our business and management program, with a focus on entrepreneurship and enterprise development, aims to supplement the sound technical expertise of our students with the tools that they need to succeed in the business world.

GIKI's location - a beautiful campus nestled amongst picturesque hills in Topi, Khyber Pakhtunkhwa, a ninety-minute drive from Islamabad is another competitive advantage. The serene surroundings provide an ideal learning environment. The clean air and natural beauty of the area also promote health and well-being, which is vital for students to perform their best academically. Our student body is incredibly close knit, with most of our students residing on campus. This also means that our faculty - many of whom are leading figures in their academic fields are always accessible to students.

The Institute's infrastructure facilities such as state of the art smart classrooms, laboratories, sports facilities, and residential hostels offer a fully supportive environment for study, research, creative and co-curricular activities.

I want to thank our able Rector and the other members of our distinguished faculty for their leadership. We are fortunate to have a body of experienced and dedicated supervisors, teachers, and support staff, who are important assets to the Institution. All faculty members recognize their key role as teachers and mentors to our young students, who can rely upon them for their guidance and support.

I am confident that the Ghulam Ishaq Khan Institute of Engineering Sciences and Technology will provide an excellent academic experience for those who choose to pursue their education with us. Our focus on excellence, innovation, and creativity will help our students succeed in whatever career path they choose.

On behalf of SOPREST, I invite all prospective students and their families to consider GIKI as a pathway to a successful and meaningful career.

Engr. Salim Saifullah Khan
President, SOPREST

FROM THE RECTOR

As the Rector of GIK Institute, I am pleased to introduce you to our esteemed institution, which is dedicated to providing students with a comprehensive and dynamic learning experience. Our faculty, students, and staff work together to achieve excellence in education, engineering, technology, and innovation. Our commitment to excellence has earned us recognition, nationally and internationally, as a symbol of quality education, with alums holding prominent positions in multinational companies and organizations across 70 countries.

At GIK Institute, we believe that the foundation for success in life and career lies in critical thinking, research, multidisciplinary perspectives, practical skills, and professional competence. Our faculty and officers are dedicated to helping students cultivate these skills and become future leaders in their respective industries. Our programs are based on an Outcomes-Based Education system, ensuring that students receive a top-notch education that prepares them for success in their careers.

The GIK Institute experience extends beyond the classroom. Our fully residential campus, spanning over 400 acres amidst the verdant greenery surrounding the Tarbela Dam, offers students an unparalleled living, academic, and extracurricular experience. With state-of-the-art labs, smart classrooms, vibrant student societies, and a business incubator, students have the ideal environment to develop their skills, discover their abilities, and achieve their goals.
Admission to GIK Institute is based solely on merit, and we are committed to making our institution accessible to all. We offer scholarships and financial assistance opportunities for meritorious and deserving students. At GIK Institute, we are also dedicated to promoting sustainable development and aligning our operations with the United Nations Sustainable Development Goals (SDGs). We believe it is our responsibility to educate and inspire future leaders to tackle the world's most pressing challenges and work towards a more sustainable future.

At GIK Institute, we aim to foster an environment that encourages our students to reach their full potential. Our supportive community and ample opportunities for involvement make GIK Institute the ideal place to pursue your passions and achieve your goals, while also contributing to a more sustainable future.
I extend my heartfelt gratitude to our alums, Board of Governors, and friends for their strong support in making this possible. I invite you to join the GIK family and wish you the best in your endeavors to achieve your dreams.

Prof. Dr. Fazal Ahmad Khalid, SI
Rector

Campus

Board of Governors	06
International Advisory Board	06
Campus Life	08
Genesis	08
Aims & Objectives	08
Facilities	09
Library & Information Services	10

Academics

The Graduate Programs	16
Admission	16
Fees and Expanses	17
Organization	19
Rules and Regulations	20

Facilties

Faculty of Computer Science and Engineering	23-40
Faculty of Electrical Engineering (Electronics & Power)	41-56
Faculty of Engineering Sciences	57-72
Faculty of Mechanical Engineering	73-88
Faculty of Materials and Chemical Engineering Chemical Engineering Program	89-111
Department of Civil Engineering	112-124
School of Management Sciences	125-133
Alumni/Student Impressions	134-142

BOARD OF GOVERNERS

The Board of Governors sits at the apex of the statutory pyramid of the Institute and its composition is the same as that of the General Council of the Society for the Promotion of Engineering Sciences and Technology. It has overall control of the Institute and has the powers to create new components of the Institute such as a school, faculty or any other teaching or research unit, and to change constitution of its Executive Committee and Governing Council.

The following are the members of the Board:

President
Engr. Salim Saifullah Khan

Executive Director
Mr. Shakil Durrani

Members
Mr. M. Adil Khattak
Kh. Zaheer Ahmad
Mr. Osman Saifullah Khan
Dr. Samia Altaf

Secretary SOPREST and BOG
Mr. Irfan Ahmad

Other Members
Mr. Shah Faisal Afridi
Dr. Muhammad Zubair Khan
Mr. Tariq Iqbal Khan
Mr. Iftikhar H. Shirazi

Ex-officio Members
Chairman, Higher Education Commission (HEC)
Chairman, Water and Power Development Authority (WAPDA)
Executive Director, SOPREST
Secretary, Finance Division, Govt. of Pakistan
Chief Secretary, Khyber Pakhtunkhwa
Secretary Science & Technology and Information Technology, Khyber Pakhtunkhwa

INTERNATIONAL ADVISORY BOARD

The founding fathers of the Institute were conscious of the fact that in spite of all the idealism one may have, new institutions tend to regress towards the existing models, and fail thereby to live up to the ideals which inspired their creation. They, therefore, took care to build monitoring devices to keep up Institute's standards of education and research. One such device is the International Advisory Board consisting of scientists, engineers, and academicians of international standing. The Board sets up international standards for the Institute in terms of the quality of education and research, caliber of the faculty, revision and review of the curricula, and adequacy of the laboratory and library facilities. It also reviews the developmental programs of the Institute and provides guidelines for its growth in future.

The present Advisory Board comprises the following:

Prof Dr. Shuichi Miyazaki
Institute of Materials Science, University of Tsukuba, Japan.

Prof. Dr. Di Su
The University of Tokyo, Japan

Dr. Zahid Ayub
President Isotherm, Inc., Texas 76001, USA

Dr. Kamran Iqbal
Department of Systems Engineering, University of Arkansas at Little Rock, 2801 S. USA

Dr. Muhammad Suhail Zubairy
Department of Physics, Texas A&M University, College Station, TX 77843-4242, USA

Prof. Dr. Samee Khan
Department of Electrical & Computer Engineering, Mississippi State University, USA

Prof. Dr. Joseph D. Smith
Wayne and Gayle Laufer Endowed Energy Chair, Missouri University of Science and Technology, USA

Dr. Bilal Malik
Clinical Imaging Senior Scientist, Personalized Healthcare, Genentech, DNA Way,
South San Francisco, CA 94080, USA

Prof. Dr. Kaifeng Yang
Florida State University Tallahassee, Florida 32306-2250, USA.

Prof. Dr. Hanif Chaudhary
University of South Carolina, Columbia SC, USA

Dr. Costas Constantinou
School of Electronic Electrical and Computer Engineering, University of Birmingham, Edgbaston. Birmingham, UK

Dr. Talha J. Pirzada
Department of Materials, University of Oxford, UK

Dr. Julfikar Haider
Department of Engineering, Manchester Metropolitan University, UK

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Dipartimento di Matematica e Informatica, viale Morgagni, 65, 50134 - Firenze, Italy

Dr. Jianfu Zhang
Department of Mechanical Engineering, Tsinghua University, 100084, Beijing, China

Prof. Dr. Yan Bing
Tianjin University of Technology and Education TUTE, China

Prof. Dr. Shahbaz Khan
Director, UNESCO, Beijing, China

Prof. Dr. Kai Sang Lock
Singapore Institute of Technology, Singapore

Prof. Dr. Manuel Andres Rodrigo Rodrigo
Faculty of Chemical Sciences and Technologies. University of Castilla-La Mancha, Chemical Engineering Department., Spain

Dr. Nikoletta Athanassopoulou
Institute for Manufacturing, University Of Cambridge, UK

Dr. Arsalan Ghani
Institute for Manufacturing, University Of Cambridge, UK

Prof. Dr. Jawwad Darr
Dept. of Chemistry, Faculty of Maths & Physical Sciences, University College London, UK

GENESIS

The genesis of the Institute goes back to the early 50's when Mr. Ghulam Ishaq Khan, during his close association with the Water and Power Development Authority and the Pakistan Industrial Development Corporation, became acutely aware of Pakistan's dependence on foreign expertise and imported technology. His frequent interaction with foreign and local experts led to the idea of a center of excellence in engineering sciences and production technology whose standard of education would be comparable to those of its counterparts in the advanced countries. The transformation of this idea into a practical proposition took place in December 1985 when the Benevolent Community Care and Infaq Foundation donated Rs. 50 million for setting up an Institute, and the NWFP (the former Khyber Pakhtunkhwa province) Government donated 218 acres of land for its campus.

A milestone in the evolution of the Institute was the registration, in June 1988, of its parent body, namely the Society for the Promotion of Engineering Sciences and Technology (SOPREST) in Pakistan. Mr. Ghulam Ishaq Khan, the President of the Islamic Republic of Pakistan at the time, was elected president of the Society for life and Mr. H. U. Beg was appointed its honorary Executive Director.

The task of conceiving and formulating the basic structure and features of the Institute was entrusted to a group of eminent scientists and engineers. Civil works at the campus site were started in early 1990. An interim office of the Institute was set up in August 1992 where experienced professionals worked on the educational aims and philosophy of the Institute, its curricula, details of equipment for its laboratories and workshops. The ordinance for the establishment of the Institute was promulgated by the NWFP Government in March 1993 and the first batch of students entered its portals in October 1993.

AIMS AND OBJECTIVES

It is the first not-for-profit, non-governmental Institute of its kind in the country and is dedicated to bring our engineering education at par with that of the advanced countries. The aim of the Institute is to pursue excellence in education and research by developing appropriate curricula and teaching practices, acquiring talented faculty and providing

an environment conducive to teaching and learning. Its graduates are expected to possess high professional competence combined with the humanistic and moral values envisaged in its Profile of the Graduates.

The educational philosophy of the Institute emphasizes training of the mind rather than stuffing it with an inert body of facts; on expanding the scientific imagination of the students rather than making them tread well-worn and outmoded grooves of thought. Guided by such convictions, the Institute educates its students by confronting them with real-life problems and inculcating in them a problem-solving approach. They are encouraged to explore and solve problems, to break new grounds and to cultivate leadership qualities.

Pakistan is on the threshold of a major breakthrough in the techno-industrial fields and needs professionals with ability and vision to lead the way. The Institute aims at producing such professionals with a strong base of engineering education and research. It strives to produce graduates who can upgrade existing technological activities in the country and in whom professional excellence is inseparable from a commitment to the national ideals.

CAMPUS

Spreading over an area of more than 400 acres, the Institute is located near Tarbela Dam in nature-rich countryside of the Khyber Pakhtunkhwa Province, which has been the cradle of many civilizations since ancient times. The Institute has self-contained world of its own and provides first-rate academic environment and civic amenities to its students and employees.

SPORTS FACILITIES

Sports Complex is located in close proximity to the student's hostels. It spreads over an area of 3100 Sq. Yds. With a covered area of 31 Sq. Ft. It consists of a completely covered swimming pool of international standard with comprehensive facilities, Squash Courts and a Gymnasium. The Gymnasium consists of a main hall and an exercise room. The main hall houses the facilities to play Basketball, Volleyball and Badminton. In the exercise room, modern equipment for various physical exercises have been installed. Common facilities such as lockers, showers, storage, checkroom, administrative offices and refreshment rooms have been provided. A separate ladies gym is also operative in the sports complex. Grounds are available for outdoor sports like tennis, basketball, volleyball, football and cricket etc. There are hiking and jogging tracks in the hills behind the main buildings of the Campus.

CIVIC AMENITIES

Away from the congestion, noise and pollution of big cities, the Institute makes available all things essential for a comfortable and good living.

HEALTH & MEDICAL FACILITIES

The Institute has its own Medical Center in the campus that provides medical facilities to its employees, their families and students on 24/7 basis. The patients are provided free medical care which includes the ambulance service, medicines, lab investigations and other tests. The Medical Centre comprises of 13 bed hospital supported by an operation theatre, pharmacy, x-rays and clinical laboratory with computerized equipment for a wide range of haematology, bio-chemistry and endocrinology tests.

Shopping Area: The following utility services are available at the Shopping Centre located within the premises of the Institute: General Stores, Restaurants, Barbeque Corner, Coffee Corners, Stationery Shop, Fruit and Vegetable Shop, Dry Cleaning and Laundry Service, Barber Shop, Dairy Shop, Juice Bar.

Bank: There is a branch of Habib Bank at the campus, which offers the usual banking facilities including foreign currency accounts/ATM.

Faculty club Board and ladies club cater to the entertainment and social needs of the members.

Mosques: There are three beautiful mosques on the campus, one of which is in residential area, the other near the hostels and the third one, next to the Guest House.

Service Centre provides photocopying/printing services to the staff and students.

Transport section of the Institute has 20 vehicles in its pool comprising cars, vans, trucks and air-conditioned coaches. The Institute provides pick-and-drop services to students and staff from Rawalpindi, Islamabad and Peshawar on weekends, mid and end of semester breaks, industrial tours and picnics. Day and night emergencies are attended to by the ambulance service and duty vehicles. In emergency, students and employees are transported to Rawalpindi, Islamabad or Peshawar by Institute vehicles.

GIKafe: We take great pride in serving the GIK

community. The Gikafe is tailored to the specific tastes and needs of the individuals who live and work there. In the GIKafe you'll find a range of tasty and diverse choices and environments, meeting your needs if you're on the go, if you need a quiet space to dine, or if you want to convene a group of friends or colleagues for a meal. There's something for everyone and we invite you to explore campus and the variety of foods available in the GIKafe. It caters for the requirement of the Societies as well. GIKafe is open to all members of the GIK community and their accompanied guests.

Parents Lodge: In view of the difficulties faced by the visiting parents/guardians for overnight stay, a parents lodge has been set up near the students' hostels. It is a five-room fully furnished and air conditioned accommodation. This accommodation is available to parents and guardians on first-come-first-serve basis on reasonable charges for short visits. Efforts are made to make their stay as comfortable as possible.

Guest House:

The first building which was constructed right at the inception of the Institute stay at the Campus. It is situated close to the main entrance of the Institute and is centrally air-conditioned and fully furnished. It has ten bedrooms and a big lounge for indoor functions. Guest house provide the visitors and parents the facility of short stay at campus.

Auditorium:

A spectacular auditorium occupies the central place in the campus and its dome meshes with the surrounding hills to present a breath-taking skyscape. It has a seating capacity of 535 and is a venue of conferences, seminars, debates, declamation contests, concerts, and other such functions. A lavishly furnished conference room, a seminar/workshop and a service centre are also parts of this block.

LIBRARY AND INFORMATION SERVICES

A stately three-story building, set against the background of brooding and austere hills of Tarbela, houses the Central Library of the Institute. Its interior design, decor, and furniture create an atmosphere of an intellectual sanctuary wherein the students and faculty can concentrate on their studies. It operates in two shifts and remains open till late in night seven days a week. It has textbooks, reference works, printed as well as online journals to meet the needs of students and faculties. To share resources through interlibrary loan and exchange of databases, it is electronically linked to all prominent libraries of the country. It also provides reprographic services.

The GIK Institute's digital library provides access to resources of HEC that include databases of journals and books to support the faculty and students community of the Institute. The digital resources include about 15000 electronic journals, 80,000 e-books, audio/video materials, IEEE databases on DVDs and other reference databases. The students and faculty members at the Institute can easily access all the resources on their desks through http://www.digitallibrary.edu.pk/giki.html, which provides online access to IEEE, ProQuest Dissertation & Theses, ASTM, Ebrary, Springer link, Taylor & Francis Journals, Wiley-Blackwell Journals.

Wireless network is available in the library and open for all users. Student society Meeting/Discussion Rooms are available in library on request.

Turnitin software for plagiarism detection service is also available to facilitate the students to improve the writing skills.

STUDENT ACCOMMODATION

The accommodation facilities for students are entirely on-campus. There are eleven hostels for boys, one separate hostel for girl students and one female graduate hostel. The rooms in the hostels are equipped with modem furniture and attached bathroom. The Institute provides shared accommodation to all freshmen and sophomore students. Single rooms are usually allotted to the senior students on merit basis.

FACULTY AND STAFF RESIDENCES

The Institute is fully residential. The entire faculty and staff of the Institute are accommodated in independent houses and flats on the campus.

GIKI SCHOOL AND COLLEGE

Affiliated with the FBISE, the GIK College provides quality education to the employees' wards. Originally meant for the employees' children it now also offers admissions to the local private students. Being the most aspired for educational institution in the area, its student enrolment has risen to 740, in a very short period of time. It has a highly qualified and experienced staff possessing compulsory Masters, B.Ed and M.Ed degrees. Besides providing quality education, it lays great stress on the development of the students' personality, civic and hygiene sense. In this regard students are actively engaged in co-curricular activities, sports events, educational trips and campaigns. The Annual Art and Science Exhibitions showcase students' creative skills in art, craft and science. The College football and cricket teams have several inter- collegiate sports titles to their names. The students living at the campus also have an access to the central library, medical center, sports complex with a swimming pool and gym, and café.

INCUBATION CENTER-THE CATALYST

To create impact in entrepreneurial ecosystem of the region, the Institute launched an incubation Program called The Catalyst back in 2014. It is the only residential incubator in Pakistan which offers a wide range of services to build the future large enterprise. The companies are provided various facilities including free accommodation on campus, office space, stipend for each founder, access to all the labs, workshops and resources of the Institute. It is a specialized program focused on bringing the technology-intensive start-up ideas to life. The Science and Technology Department of KP have extended valuable financial and technical support for the Incubation Center.

SOCIETIES AND TEAMS

The institute is situated in calm and tranquil countryside. The campus of the institute is a self-contained cosmos. Here the students generate a fullness of life for themselves, and their superabundant energies find outlets in a host of socio-cultural activities. Through generous financial allocations and faculty supervision, the institute supports all modes of constructive self-expression for the students. There is thus much on the campus by way of recreational facilities, which mitigate the rigors of very demanding academic engagements. To nurture the intellectual and recreational activities, students are encouraged to join student societies in GIK Institute which are managed by students with the support of faculty and administration. Each society is assisted by a faculty advisor. Different kinds of technical and recreational events are organized by these societies which range from scientific to art competitions.

STUDENT SOCIETIES AT GIK INSTITUTE:

GIK Institute recognizes a wide variety of student societies to facilitate diverse interests of the student body. Office of Student Affairs is the governing body for all societies that are administered by student representatives. Societies are granted certain privileges to promote student participation in a variety of physical, intellectual and recreational activities.

There are many student societies in GIK Institute which support contemporary scientific and engineering perspectives as well, and are devoted to advance theory and practice of their respective fields. Few of student societies which have contributed to GIK Institute, are discussed below:

1.Science Society

It provides opportunities to students to nurture their scientific talents. It arranges video shows on contemporary developments in various scientific fields. It encourages and financially backs scientific projects undertaken by students on their own initiative. It provides a forum where students and teachers can get together to exchange ideas and information on scientific topics beyond the confines of the formal curricula.

2.AIAA - (American Institute of Aeronautics and Astronautics) GIK Chapter

The American Institute of Aeronautics and Astronautics (AIAA) is a prominent technical society at GIK Institute. Formerly known as the GIKI Aerotech Club, it has made its mark by projecting an image that makes this technical society appealing to the masses. The society is a platform for Aerospace enthusiasts and it conducts various events, seminars and workshops each year. AIAA also maintains a fleet of Radio Controlled Aircraft which are used for both technical and recreational purposes.

3.ASM/TMS – (The Mineral, Metal & Material Society/American Society of Materials) GIK Chapter

The mission of ASM/TMS is to promote the science and engineering professions concerned with minerals, metals and materials. The objective of this TMs chapter is to make students aware of the role of materials and metallurgical engineering in today's international market place. TMS also helps students from other disciplines of engineering to better understand and perform in their disciplines of engineering materials.

4.ACM - (Association for Computing Machinery) GIK Chapter

ACM is a worldwide professional organization devoted to advancing the theory and practice of computer science. Its student chapter at GIKI is involved in activities ranging from arranging students workshops, special courses and introductory seminars to holding software and computer games competitions.

5.Women Engineering Society (WES)

The Women Engineering Society has undertaken the task of exploring the reasons behind the low representation of women in the field of engineering and seeking remedial measures to make this profession more viable for women. To fulfil this need, a student society (Women Engineering Society) has been established, which is wholly managed by female students. It has successfully arranged two national symposiums to discuss the problems faced by women in this field and also the problems faced by the industry in hiring and retaining of women engineers. The feedback has been enormously encouraging and WES plans to keep working at raising awareness about the viability of engineering profession for women.

6.Literary and Debating Society (LDS)

The society holds debates, declamation contests and literary evenings, and sessions of poetry recitation. It also arranges participation of the GIKI teams in debates and declamation contests held by other universities. LDS is the oldest society of the institute. A special feature of its agenda is the student teacher discussion usually held in the auditorium. These collective sessions prove invaluable for a critical evaluation of the diverse aspects of the campus life, and go a long way in promoting rapport between the students and the faculty. The LDS also organizes and participates in international events.

7.Cultural, Dramatic, & Entertainment Society (CDES)

This is one of the most active and widely applauded societies which add colors to the campus life. It creates entertaining and healthy diversion throughout the year by organizing musical concerts, drama festivals, skit competitions, picnics, and bonfires. The activities of the society help in identifying artistic talent among students and nourish students to participate in art competitions. The society also celebrates the much popular "Basant Festival" every spring.

8.SOPHEP- (Society for the Promotion of Higher Education in Pakistan)

In this modern day and age, engineers and scientists are not isolated from the management of the firms they work in. As a matter of fact, they themselves can become senior managers later on. Due to this, companies are perpetually on the look-out for people with solid communication skills. The implication for students is that besides studying hard, they must strive to develop solid presentation and communication skills as well. One of the major problems facing today's Pakistani students is the lack of interaction between the Pakistan's academic and professional communities. As a result of this, young undergraduates lack sufficient knowledge of the professional world and companies remain unaware of the great potential of these future workers. In this regard, SOPHEP bridges the gap among these two vital communities. SOPHEP holds workshops that are conducted by successful GIKI alumni that help students to refine their people-skills and professional grooming.

9.Project Topi

Project Topi is a student based society which works for the social uplift of the people living in and around the GIK Institute. This society began back in 2000 with the aim of academic uplift of the people of Topi and other parts of Swabi. Over the Years the domain stretched to areas like medical initiatives, blood camps, and woman/men empowerment, micro-financing and continual support of some very poor families as well.

10.NAQSH

Naqsh Art Society is another emerging and popular student society. It organizes the much awaited 'All Pakistan Art Gala' every year, featuring various artistic competitions on a national scale. The society promotes aesthetic sense and faster artistic touch among the prospective engineers.

11.Media Club

To promote creative expression amongst the students, the GIKI Media Club caters for the taste of all. It comprises of Photography Club, Desktop Publishing and vision Club. Emphasis is laid both on still photography and video. The members are supposed to compile and compose the newsletters/magazines. The media club is responsible for the coverage of various events within the Institute and also organizes the very popular annual movie competition at the campus.

12.Sports Society

Sports Society comprises of the coordinators of various sports clubs of the Institute. It promotes and regulates sports and games on the campus. The existing facilities include a sports complex, which houses Swimming Pool, Squash, Basketball, Volleyball & Badminton Court and a Gymnasium. Outdoor facilities include cricket, hockey, football fields, tennis courts, beach soccer, and beach volleyball. Students' hostels have ample provision for the indoor games, such as table tennis, carom and chess. The Society organizes friendly matches throughout the year culminating in annual interfaculty tournaments and competitions. The sports society also organizes fixture tournaments with other educational institutions and provides the forum for sportsmen to take part in various national sports events.

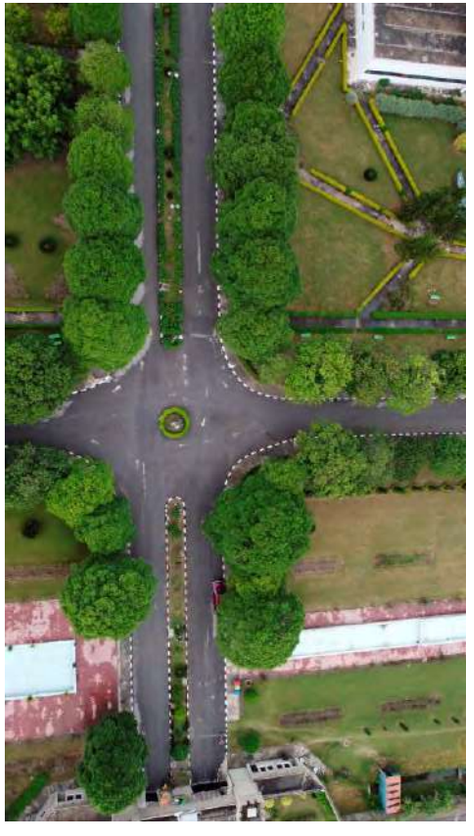
13.Graduate Students Society (GSS)

GIK Graduate Students Society is the only and most active society for the post graduate students of GIK Institute. It provides postgraduate students a platform for educational development, healthy activities and entertainment, while staying on campus. GSS organizes All Pak's, seminars, workshops and tutorials in different fields of science & technology to nourish the research skills of students. Speakers from around the world are invited to give talk on the latest and emerging fields of science. GSS keeps alumni and currently enrolled students connected so that they can exchange ideas and experience the research and development which is going on in different fields.

GSS arranges an outdoor recreational tour, sports week, welcome and Farewell dinner every year to keep postgraduates active and fresh for their research and studies. GSS emphasizes to maintain quality research and academia environment in GIK institute.

Following students societies are functional in the Institute:-

1. ACM GIK Chapter: Association of Computing Machinery
2. ASME GIK Chapter: American Society of Mechanical Engineers
3. ASM/TMS GIK Chapter: American Society of Materials/the Materials, Mineral and Metal Society
4. ASHRAE GIK Chapter: American Society of Heating, Refrigerating and Air Conditioning Engineers.
5. CDES: Cultural, Dramatic and Entertainment Society
6. GMS: GIKI Mathematic Society
7. GSS: Graduate Student Society
8. IET GIK Chapter: Institute of Engineering and Technology
9. IEEE GIK Chapter: Institute of Electrical and Electronic Engineering
10. LDS: Literary and Debating Society
11. Media Club: Includes GIKI Vision, Photography and Desktop Publishing
12. Naqsh Art Society: NAQSH promotes and propagates art in GIK Institute.
13. Netronix: NETRONIX is the caretaker of the hostel network which consists of over 600 workstations.
14. Project Topi: Project Topi is a student run volunteer society which runs many projects for the welfare of Topi community.
15. Web Team: The GIKI Web team is an in house team of students that voluntarily design and manage the GIKI website and its related affairs, with their services being officially recognized by the Institute.
16. Science Society: Science society deals in contemporary developments in scientific field.
17. SOPHEP: Society for the Promotion of Higher Education in Pakistan
18. Sports Society: Sports society maintains the sports facilities and organizes events with wide participation.
19. SPIE GIK Chapter: Society for Photo-Optical Instrumentation Engineers
20. SMEP GIK Chapter: Society of Mechanical Engineers of Pakistan
21. WES: Women Engineers Society
22. AIAA GIK Chapter: American Institute of Aeronautic & Astronomic.
23. AIESEC: Its agenda primarily includes sending youth for exchange programs, belonging to different cultures to other countries. It is an attempt to develop and consolidate friendly ties between countries.
24. AICheE GIK Chapter: American Institute of Chemical Engineers, GIKI Chapter.
25. CBS: Character Building Society
26. ImechE: institute of Mechanical Engineering.
27. LES: Leadership and Entrepreneurial Society.
28. ICE: Institution of Civil Engineers
29. GIKI Adventure Club



Prof. Dr. Syed Mohammad Hasan Zaidi

Pro-Rector (Academic)

Prof Dr Syed Mohammad Hasan Zaidi, is the chief academic officer overseeing academic and research pursuits of the University, ensuring the growth and prosperity of its students, faculty and allied academic staff. He is supported by Dean, HoDs and Directors.

What We Offer

Programs	BS	MS	PhD
Artificial Intelligence	✓		
Computer Engineering	✓	✓	✓
Computer Science	✓	✓	✓
Cyber Security	✓		
Chemical Engineering	✓	✓	✓
Civil Engineering	✓	✓	✓
Software Engineering	✓		
Engineering Management		✓	
Electronic Engineering		✓	✓
Data Science	✓		
Electrical Engineering	✓	✓	✓
Engineering Sciences	✓	✓ *	✓ *
Management Sciences	✓		
Material Engineering	✓	✓ **	✓
Mechanical Engineering	✓	✓	✓
Nanotechnology & Materials Engineering		✓	

THE GRADUATE PROGRAM

The Graduate Program at GIK Institute is designed to meet the international standards. It is a significant step towards reducing the nation's reliance on technically advanced countries for higher education in engineering, computing and other major sciences and business management. The faculty, research laboratories, equipment and library facilities provide easy access for the students to the latest corpus of knowledge in their fields of specialization. Our students may have opportunities to complete part of their studies at reputed universities abroad under various split degree programs.

The GIK Institute's graduate program is a major stride in the evolution of engineering and computing education and research in the country and brings about a qualitative change in these fields. This will, it is envisaged, promote productive liaison between the Institute, and industry and businesses. The research component will focus mainly on the problems of national industry and society and will act as a conduit for the inflow of latest know-how because of the collaboration with universities and research organizations in the advanced countries. Hence the program will produce specialized engineers, professionals, and scientists who have the urge, the attitude, and the skills to lead techno-industrial transformation of the country.

The GIK Institute has undertaken an exciting venture in engineering education and research of the highest order and provides to its students facilities for professional training and growth for which studies at universities of advanced countries were considered indispensable. The Institute welcomes graduate students to participate in this venture by joining one of its graduate programs.

Degree Programs

The Graduate School offers MS and PhD degrees in the following areas:

MS Degree Programs
1.Chemical Engineering
2.Civil Engineering
3.Computer Engineering
4.Computer Science
5.Electrical Engineering
6.Electronic Engineering
7.Engineering Sciences (Engineering)
8.Engineering Sciences (Applied Mathematics)
9.Engineering Sciences (Applied Physics)
10.Mechanical Engineering
11.Materials Engineering
12.Nanotechnology and Materials Engineering
13.Engineering Management

PhD Degree Programs
1.Chemical Engineering
2.Computer Engineering
3.Computer Science
4. Civil Engineering
5.Electrical Engineering
6.Electronic Engineering
7.Engineering Sciences (Engineering)
8.Engineering Sciences (Applied Mathematics)
9.Engineering Sciences (Applied Physics)
10.Materials Engineering
11.Mechanical Engineering

ADMISSION

Fresh induction to the graduate program is conducted twice a year in fall and spring semesters. Applications are invited each year in May-June for fall semester and in October-November for spring semester. Admission of students to GIK institute is strictly on the basis of merit. There are no special quotas, reserved seats or admission by donations, nor is there any arbitrary age limited for the applicants. The institute is guided by the following principle:

"The institute is open to all persons on merit without any discrimination on the basis of religion, creed, gender or race"

ELIGIBILITY

MS Degree Program
Graduates in Engineering and Sciences from HEC recognized institutions who have:

§ A minimum of sixteen years of schooling or 4 year education after FA/FSc (130 credit hours) in the relevant discipline.
§ Sound academic record (60% marks or equivalent) throughout the academic career.

PhD degree program
§ Applicants with minimum CGPA of 3.00 or above at MS/M.Phil and overall 60% marks throughout the academic career.
§ HEC conditions apply.

Intra-disciplinary Program
Prospective students can pursue interdisciplinary admissions by meeting specific criteria. These include demonstrating a strong interest in an interdisciplinary program, completing 6-9 credit hours of deficiency courses, and obtaining approval from the admission committee in addition to fulfilling the institute's admission requirements. The applicant should pass GRE Subject/equivalent test with minimum 50% marks in the discipline of admission.

WRITTEN TEST/ INTERVIEW
Candidates have to pass GRE/ETC (General) or GIK Institute Graduate Admission Test and Interviews.

APPLICATION PROCEDURE
The filled in online application form along with the following supporting documents/materials must reach the Graduate Admissions Office, GIK Institute, Topi before the closing date . Any application which is late, incomplete, unaccompanied by any supporting document/material or application fee will not be processed. Applicants who do not fulfill the eligibility criteria for admission will not be shortlisted.

1.Printed copy of online application form.
2.Paste one recent passport size color photograph in the space provided on application form.
3.Original receipt of application processing fee Rs. 1,000/- (nonrefundable) drawn on any online branch of Habib Bank Ltd. A/C No. 19790000085901.
4.Attested copy of the result card: GRE/ETC (General) Test (if any).
5.Attested copy of CNIC
6.Attested copies of:
  i.O-Level/SSC Certificate and DMC
  ii.A-Level/HSSC Certificate and DMC
  iii.BSc/BS Degree and Transcript
  iv.MSc/MS/MPhil Degree and Transcript (for PhD candidates)
7.Research Proposal / One-page summary outlining the applicant's previous research and/or his/her practical experience. He/she should also indicate his/her academic and research interest at GIK Institute and work interest after getting his/her degree (statement of purpose).
Two letters of recommendation signed by the referee (class teacher of the last Institution attended) to vouch for the applicant's academic record and performance.

TRANSFER WITH ADVANCED STANDING
A maximum of 6 credit hours (for PhD) and 9 credit hours (for MS) graduate work done at some PEC accredited and HEC recognized Institution may be transferred with the recommendation of the faculty, provided that;
i.The course work fits into a logical program for the degree.
ii.A minimum of grade B has been earned.
iii.The transfer is approved by the office of graduate studies.
Transfer of research work of a student could be allowed if accepted by the host supervisor. However, to qualify for credit transfer, a candidate will qualify the admission test of GIK.

FEES AND EXPENSES
The Institute is a non-governmental, non-profit organization providing subsidized education. The details of tuition fee and other expenses may be obtained from the Graduate Admissions Office or the website www.giki.edu.pk.

The tuition fee is payable before the commencement of the fall/spring semester each year. A non-refundable admission fee is also required to be deposited along with the annual tuition fee. Another amount will be charged as security, refundable at the time of leaving the Institute subject to the clearance from relevant departments. The final year students are charged convocation fee as well.

GRADUATE ASSISTANTSHIPS
Various scholarships and assistantships are available on merit, based on performance in the admission test and interviews. The scholarships and assistantships are available in all disciplines to provide financial support to MS and PhD students which include the following:

MS Degree Program (2 Year):
i.Graduate Assistantship Scheme (GA-1)
Full Tuition Fee waiver
Monthly stipend
Free bachelor accommodation

Eligibility Criteria:
SSC/ HSSC (or Equivalent): Minimum 60% marks
BS (Eng): Minimum CGPA 2.70 or 70% marks

ii.Graduate Assistantship Scheme (GA-2)
Full Tuition Fee waiver
Monthly stipend
Free bachelor accommodation

Eligibility Criteria:
SSC/ HSSC (or Equivalent): Minimum 60% marks
BS (Eng): Minimum CGPA 2.70 or 70% marks
(2 year service at GIK Institute with annual performance as very good/ better).

iii.Partial Scholarship (PSS)
Partial Tuition Fee waiver (Annual Tuition Fee under PSS is Rs. 150,000/-)
Free bachelor accommodation

Eligibility Criteria:
SSC/ HSSC (or Equivalent): Minimum 60% marks
BS (Eng): Minimum CGPA 2.00 or 60% marks

iv. Day Scholar Scheme
Semester Tuition Fee Rs. 50000/-
Accommodation not Available

Eligibility Criteria:
SSC/ HSSC (or Equivalent): Minimum 60% marks
BS (Eng): Minimum CGPA 2.00 or 60% marks

PhD Degree Program (3 Year):

i.Graduate Assistantship Scheme (GA-3)
Full Tuition Fee waiver
Monthly stipend
Free bachelor accommodation

Eligibility Criteria:
SSC/ HSSC (or Equivalent): Minimum 60% marks
BS (Eng): Minimum CGPA 2.70 or 70% marks
MS/MPhil: Minimum CGPA 3.00 or75% marks
(2 year service at GIK Institute with annual performance as very good/better).

ii.Graduate Assistantship Scheme (GA-4)
Full Tuition Fee waiver
Monthly stipend
Free bachelor accommodation

Eligibility Criteria:
SSC/ HSSC (or Equivalent): Minimum 60% marks
BS (Eng): Minimum CGPA 2.70 or 70% marks
MS/MPhil: Minimum CGPA 3.00 or75% marks

iii.Graduate Assistantship Scheme (GA-F)
Full Tuition Fee waiver
Free bachelor accommodation

Eligibility Criteria:
SSC/ HSSC (or Equivalent): Minimum 60% marks
BS (Eng): Minimum CGPA 2.50 or 65% marks
MS/MPhil: Minimum CGPA 3.00 or75% marks

iv. Day Scholar Scheme
Semester Tuition Fee Rs. 50000/-
Accommodation not Available

Eligibility Criteria:
SSC/ HSSC (or Equivalent): Minimum 60% marks
BS (Eng): Minimum CGPA 2.50 or 65% marks
MS/MPhil: Minimum CGPA 3.00 or75% marks

Note: The graduate assistants shall be required to assist the faculty in teaching and research activities and to sign a service bond with the Institute at the time of admission.

ACADEMIC CALENDAR
An academic year comprises two regular semesters of sixteen weeks each, and an eight-week summer school. The schedule of two semesters and summer school is:

Fall: August to December
Spring: January to May
Summer: June to July

The last week of a semester is reserved for the final examinations. There is normally a mid-semester break during a regular semester.

Graduate Students' Advisors
All students are assigned advisors for general academic guidance and to help them in selecting courses. Later on the project/ thesis or dissertation adviser guides students on all academic matters.

Controller of Examinations

The Controller of Examinations is responsible for maintaining and compiling results, issuing result cards and transcripts.

Credit Hour System
The credit hours assigned to a theory or a laboratory course depend on the contact hours allocated to it per week throughout a semester. For a theory course one credit hour is equivalent to one contact hour of lecture per week, and for a laboratory course, three contact hours of practical work per week constitute one credit hour.

Student Evaluation
Students are evaluated on the basis of mid-semester examinations, home assignments, quizzes, case studies, course projects, lab reports, the end-of-semester examination, etc.

Grading System
Depending on their academic performance, students are awarded letter grades, which are shown in the following table:

Each grade is assigned Grade Points per Credit (GPC). The following table indicates the grades from excellent to failure using fractional grades:

A	Excellent
B	Good
C	Minimum Acceptable
I	Incomplete
F	Failure
W	Withdrawn
E	Exempt

The academic standing of a student is referred as his/her Cumulative Grade Point Average (CGPA) which is the ratio of the total number of grade points earned to the total number of credits attempted. The minimum CGPA to fulfill the degree requirements is 3.00 on the scale of 4.00. I and W grades are not counted in calculation of GPA.

Grade	GPC
A	4.00
A-	3.67
B+	3.33
B	3.00
B-	2.67
C+	2.33
C	2.00
F	0.00

Repeating Courses
Courses in which students secure F grade, and which are a requirement for the degree have to be repeated in its entirety. They may opt for a substitute course(s) only if there is an alternate available in the curriculum. Students can repeat courses for which they obtained F, C or C+ grade, on the condition that they repeat the courses within 3 semesters after the semester in which they obtained these grades. In case of repeated courses, all grades earned by students appear in the transcripts. However, only the latest grade will be counted for the Cumulative Grade Point Average, even if it is lower than the earlier one.

Registration Schedule
Students have to register for their courses during the period specified for the purpose before the commencement of a semester. Before the start of every semester, the office of the Controller of Examinations notifies the registration deadline. Requests for late registration for valid reasons can be entertained by the Pro-Rector (Academic) till the end of the third week of a semester.

Withdrawal from Courses
Students may withdraw from one or more courses with the approval of their Dean between the 4th and 10th week of a semester. In such cases, a W grade appears on their transcripts. Any withdrawal after the 10th week entails award of an F grade in the course.

Incomplete (I) Grade

An I grade is given to students in a course in which they:

Do not appear in the final examination due to valid medical reasons.
Do not complete its requirements within the prescribed time-limits, and the instructor is convinced that it was because of circumstances beyond the control of the student, and that only a minor component of the course is outstanding.

The outstanding requirement, in such cases, is to be met during the first two weeks of the next semester, and the students themselves are responsible to make arrangements for the purpose with their instructors. Failing this, the (I) grade is converted to F grade. They cannot re-register for a course in which they have the (I) grade. The grade point average of a student for a semester is calculated excluding the (I) grade and it is re calculated when a regular grade has been awarded for the course.

ORGANIZATION

Graduate School
The Graduate School administers Graduate Study at GIK Institute and is run by the Graduate Council comprising the Pro-Rector (Academic), Graduate Dean, Dean of each faculty and two faculty members nominated by the Rector on the recommendations of the Graduate Council. The Graduate Council formulates the basic policy, procedures, and requirements for all graduate programs at GIK Institute within the general authority granted by the Governing Council of the Institute. The Graduate Council establishes admission standards and periodically reviews all existing graduate programs. Major decisions of the Graduate Council may be referred to the Governing Council for review and approval.

Graduate Dean
The Graduate Dean overseas all graduate programs across the Institute and assures the procedural details and integrity of the graduate programs.

Graduate Admissions Officer
The graduate admissions officer works in co-operation with faculties and departments to manage graduate programs. He supports administrative and secretarial services related to the provision and maintenance of graduate student records and other activities including admissions, enrolments, program information, scholarships, and student matters. This is the first point of contact for all enquiries.

Graduate Faculty
Graduate faculty comprise of highly qualified members of the Institute's faculty. They are experienced academicians with a demonstrated potential for creative work, research ability, and competency to supervise graduate students.

Faculties have a major role in the success of graduate education. The Dean of a faculty is responsible for managing the graduate program(s) and coordinates with the Graduate School.

The faculties establish and teach courses, maintain a Graduate Faculty to teach and supervise research, establish their own admission standards and specific degree requirements, within the general rules of the Graduate School, recommend graduate student

appointments, and provide advice and supervision to their graduate students.

The Graduate Student

There are four categories of graduate students:

A.GIK Institute sponsored students (Graduate Assistants)
B.Students sponsored by HEC and other organizations or self-financed.
C.Students partially funded by GIK Institute
D. Students admitted under day scholar scheme.

RULES AND REGULATIONS

MASTER'S DEGREE PROGRAM

General Requirements

For MS program, students are required to complete 8 courses (24 credits) and a research project (6 credits) in line with the HEC policy. Also a non-credit research methodology course is compulsory.

Credit hours earned during one master's program may not be used in an additional master's program in the same discipline. It is expected that under normal circumstances, all requirements for a master's degree will be completed within 4 semesters, excluding summer terms.

Study Program
A graduate student has to file his study program, duly recommended by his/her advisor to the Graduate School by the middle of the 2nd semester of enrollment as a master's degree student. A student who does not file a study program within the specified deadline is not allowed to register for the next semester.

The student's master's Study program is formulated in a formal meeting of the student and his/her advisor subject to the faculty policies and will be approved by the Dean and submitted to the Graduate School. It is the obligation of the student to complete the requirements as formulated. A petition must be submitted for any change in the study program.

Thesis/Project Defense
At least five weeks prior to the end of the semester, the thesis/project should be completed. The student through his/her advisor and the Dean shall submit a request to the Pro-Rector (Academic) for the constitution of an Examining Committee and for a defense date. The request must accompany a summary of the thesis/project (not less than 150 words) which is informative and contains a brief statement of the principal results and conclusions. The summary must bear the signatures of the student his/her research advisor and the Dean including two or three names of prospective external examiners. The Graduate Dean will constitute an Examining Committee and will announce a defense date within two weeks from the receipt of such request. The Examining Committee will comprise of four faculty members, the advisor, an internal examiner, the Dean of the faculty and an external examiner. The student should submit an unbound copy of the thesis/project to each member of the Examining Committee and office of the faculty for the faculty members of his/her faculty or the Department.

At the end of the oral examination, the Examining Committee must vote upon the outcome of the examination. If there is more than one negative vote, the student will be considered failing the examination and may retake it only once.

Within six weeks after the final oral examination, two unbound copies of the thesis/project for the library, including copies of the abstract, must be submitted to the office of the Pro-Rector (Academic). If these copies are submitted after the initial six-week period, the student may be subject to re-examination. The student must obtain on the thesis/project approval page the original signatures of his advisor and the Dean of the faculty.

Timeline Conditions for MS Thesis Defense
During the thirteenth week of a semester a student through his/her advisor will submit the request for the thesis defense. The student will provide an unbound copy of thesis to all Examination Committee and the Dean's Office. Announcement of MS thesis defense is advertised across campus. A student may pass, pass with major or minor revisions, or fail the defense. If a student intends to be a graduate, he/she must submit his/her corrected thesis to the faculty/department office two weeks prior to the convocation, otherwise it will automatically be considered for the following convocation. A student who fails the defense may defend his/her thesis again only once within six months period, failing to do so may result a termination from the program.

Residence Requirements
The residence requirement for the master's degree is at least 21 credit hours at the GIK Institute after admission as a graduate student. These 21 credits must appear on the master's program. Deviation from the residence requirement requires the approval of the Graduate Dean for which a petition to the Graduate School must be filed in a timely manner.

Time limit
All requirements for a master's degree must be completed within three years.

DOCTORAL DEGREE PROGRAM

General Requirements
Doctor of Philosophy degree is granted primarily for creative contribution in the field of engineering and affiliated sciences. Normally three years of full-time graduate work beyond the master's degree is required and a minimum of one full-time academic year must be devoted to the preparation of a thesis. The Doctoral Degree Program is designed to prepare students to discover, integrate and apply knowledge as well as to disseminate it with high professional caliber. The Doctoral dissertation should demonstrate a significant and original contribution to the field and should be written and compiled professionally following a journalistic style of the discipline.

Successful completion of at least eighteen credit hours of graduate course work beyond the master's course work are usually required for the doctoral degree along with a dissertation of eighteen credit hours and at least two research-oriented papers in international journals as its first author. At least one of the papers should be in a W-category journal as defined by the HEC during the year of publication, while the other paper may be any ISI-indexed Impact Factor journal. The publication must be related to the candidate's field of research and thesis.

The Doctoral Committee specifies the course work the procedure to be followed in developing a dissertation proposal and conducts comprehensive examination(s) of the student. The comprehensive examination will include two parts a general section and a specialized section. The general section will assess student on the core of the discipline whereas the specialized section may assess a student on area of his/her research interest.

A student seeking PhD shall be admitted to candidacy only after completion of course work and after passing the preliminary examination to defend his/her research proposal.

A dissertation is required for every candidate. The student must register for the dissertation for a period of more than one semester and it must be an original and significant contribution to scholarship, the result of independent investigation in a major area, and has to be approved by the Doctoral Committee.

A satisfactory final oral examination is required for the approval of a dissertation.

Study Program
The doctoral study program is formulated and approved subject to faculty policies in a formal meeting of his/ her doctoral committee, which consists of a minimum of three members (graduate faculty) including one member from another faculty. When the program is approved, it becomes the obligation of the student to complete the requirements as formulated. For any change in the approved program, the student has to submit a petition to the Graduate School for possible consideration.

Residence Requirements
The residence requirement for the doctoral degree is 30 credit hours which must appear on his/her doctoral Program. Deviation from the residence requirement requires an approval through a petition to the Graduate School.

Time limit
All requirements for a doctoral degree must be completed within six years.

Qualifying Examination
A student working towards the doctoral degree has to pass a written comprehensive qualifying exam within the first four semesters and research proposal defense to be passed within first five semesters but not before comprehensive exam. The qualifying examination is normally taken at the end of two semesters of course work. It should be scheduled for at least two hours. The examination will include two parts a general section and a specialized section. The general section will assess student on the core areas of the discipline whereas the specialized section may assess the student on the area of his/her research interest. The Graduate School permits only one re-examination.

The student must pass the qualifying examination by the end of his/her third semester.

Preliminary Examinations
A student working towards the doctoral degree has to defend his/her research proposal. Under normal circumstances the preliminary examination is taken near the completion of student's course work. It should be scheduled for at least two hours. Advancement to candidacy is contingent on passing the preliminary examination. If more than one negative vote is recorded, the candidate will fail the examination. The Graduate School permits only one re-examination. At least one complete academic semester must elapse

between the time of the preliminary and final dissertation defense.

Dissertation
Every candidate for the Ph.D. degree submits a dissertation embodying the results of research and giving evidence of original contribution and ability in independent investigation at least eight weeks prior to the close of a semester. The dissertation has to be a significant contribution to knowledge based on the candidate's own investigations. It must show a mastery of the literature of the subject and be written in creditable literary form. The preparation of an acceptable dissertation will require at least one full-time academic year.
Regulations concerning the doctoral dissertation are in conformity with the requirements of Higher Education Commission Pakistan.

The Institute in "Dissertation Abstracts" will publish a doctoral dissertation abstract of not more than 350 words. Candidates to the Doctor of Philosophy degree pay the required fee for the publication of the abstract in Dissertation Abstracts.

Final Examination
After completion of all other requirements of his/her degree program, the student has to pass a final doctoral examination by defending his/her dissertation. The dissertation defense is open to all. The announcement of the defense must be broadly advertised including a posting on the Graduate School's website. After the open portion of the examination, the examining committee will continue with the examination and the evaluation of the candidate's performance.

The examining committee consists of the student's doctoral advisory committee and any additional members, including professors from other institutions, whom the office of the Graduate School may recommend. If more than one negative vote is recorded the candidate will have failed the examination. No more than one re-examination is permitted.

The final defense of dissertation must be taken within four years after passing the preliminary examination. If more than four years elapse, the candidate will be required to take another preliminary examination.

Timeline Conditions for PhD Dissertation Defense
During the week eight of a semester a student through his/her advisor submits the request for the thesis defense. After preliminary scrutiny of the dissertation by the thesis committee, it will be sent at least for two foreign evaluations. If the foreign reviews are positive, within one week the Graduate Dean informs the student of the defense date to be held within two weeks. The student provides an unbound copy of thesis to all Examination Committee and the Dean's Office. Announcement of PhD thesis defense is advertised following the HEC guidelines. A student may pass, pass with major or minor revisions, or fail the defense. If a student intends to be a graduate, he/she must submit his/her corrected thesis to the faculty/department office two weeks prior to the convocation, otherwise it'll automatically be considered for the following convocation. A student who fails the defense may defend his/her again only once within six months period, failing to do so may result a termination from the program.

MISCELLANEOUS

Courses
All Courses numbered in 5xx and above will carry graduate credit. A student must take at least four courses from his own faculty.

Seminar
A non-credit one-hour seminar per semester may be required for every PhD student. The subject and timing of the seminar will be mutually agreed between the student and his advisory committee.

Petitions
A student wishing to opt out of the normal regulations and procedures may submit a written request through his/her major advisor. In reaching a decision, the Graduate School is to seek advice from the Graduate Council. The decision will be communicated to the student within three weeks of the filing of the petition. Since each petition is dealt with independently, action taken on it will not be considered as a precedent for future.

Dismissal from Graduate Program
Graduate students are expected to make satisfactory progress towards their degree program. This includes attaining a minimum CGPA of 3 (grade B) or better in all courses taken as a graduate student and for courses included in the Graduate Program, meeting faculty requirements and participating in a creative activity such as a thesis. A poor performance will lead to the dismissal from the Graduate Program. Furthermore, a student who fails the dissertation defense twice will also be removed from the Graduate Program.
Academic dishonesty and violation of the Student Conduct Regulations will also entail dismissal from the Program.

Student Conduct Regulations
Graduate students enrolled at the Institute are expected to conform to the basic regulations and policies developed to govern the behavior of students as members of the Institute community.

FACULTY OF COMPUTER SCIENCE AND ENGINEERING

Dean FCSE

Prof. Dr. Zahid Halim

PhD (NUCES, Pakistan)

FACULTY

Prof. Dr Ghulam Abbass, PhD (University of Liverpool, UK)
Prof. Dr Masroor Hussain, PhD (GIK Institute, Pakistan)
Shahab Uddin Ansari, PhD (GIK Institute, Pakistan)
Muhammad Hanif, PhD (Australian National University, Australia)
Waqar Ahmad, PhD (Sabanci University Istanbul, Turkey)
Abbas Ahmed, PhD (University of Southampton, UK)
Fahad Bin Muslim, PhD (Politecnico di Torino, Italy)
Raja Hashim Ali, PhD (Kungliga Tekniska Högskolan, Sweden)
Farhan Khan, PhD (Bilkent Univeristy, Turkey)
Taj Muhammad Khan, PhD (INRIA Saclay Ile-de-France, France)
Rashad Jillani, PhD (Florida Atlantic University, USA)
Ali Zeeshan Ijaz, PhD (Western Sydney University, Australia)
Dr. Khurram Khan Jadoon, PhD (Hanyang University, Seoul, Korea)

The faculty strives to produce competent professionals who have sound knowledge in the field of computing and information technology. Faculty is to produce graduates having enhanced creative thinking, problem solving skills and ability for lifelong learning in their professional careers, and to develop research programs to address the evolving needs of industry, academia and society.

The graduates of the Faculty of Computer Science and Engineering shall play a productive role both in the practical and research areas of computing. The Faculty uses modern technologies to enhance the learning capabilities of the students and to provide them with a stimulating and challenging environment. Emphasis is placed on the practical applications of computer systems to the software and hardware needs of the global industry in general and the Pakistani industry in particular. The Faculty offers courses leading to Bachelor's (BS), Master's (MS) and Doctor of Philosophy (Ph.D.) degrees in Computer Engineering and Computer Science.

Introduction:

The Faculty of Computer Science and Engineering (FCSE) is one of the five faculties at GIK Institute. FCSE offers two programs (1) Computer Science, and (2) Computer Engineering leading to Bachelor (BS), Master (MS) and Doctor of Philosophy (PhD) degrees in Computer Science and Computer Engineering.

FCSE employs competent faculty members qualified to accomplish the mission and goals of the Institute. When determining acceptable qualifications of its faculty, FCSE asserts primary consideration to the terminal degree in the discipline. FCSE also considers competence, effectiveness and capacity, including, as appropriate, undergraduate and graduate degrees, related work experience in the field; professional licensure and certifications; honors, awards, and recognition; continuous documented excellence in teaching, or other demonstrated competencies and achievements that contribute to effective teaching, research, scholarship and student learning outcomes.

Graduate Programs

The Faculty of Computer Science and Engineering (FCSE) offers Master (MS) and Doctor of Philosophy (PhD) degrees in both Computer Science and Computer Engineering. Both Computer Science and Computer Engineering are multifaceted disciplines and have an assortment of applications in fields ranging from arts and humanities to business and all areas of science, engineering and technology.

Computer science is the scientific and practical approach to computation and its applications. It is the systematic study of the feasibility, structure, expression, and simulation or implementation of the algorithms and methodical procedures that underlie the acquisition, representation, processing, storage/retrieval, communication access and dissemination of information. Frequently, computer science is also considered to be the study of automating algorithmic processes that scale. A computer scientist specializes in the theory of computation and the design of computational systems.

The field of Computer Science can be divided into a variety of theoretical and practical disciplines. Some fields, such as computational complexity theory which explores the fundamental properties of computational and intractable problems, are highly abstract, while fields such as computer graphics emphasize real-world visual applications. Still other fields focus on challenges in implementing computation. For example, programming language theory considers various approaches to the description of computation, while the study of computer programming itself investigates various aspects of the use of programming language and complex systems. Human—computer interaction considers the challenges in making computers and computations useful, usable, and universally accessible to humans. A graduate degree in Computer Science produces experts in one or more of these fields.

Computer engineering is a discipline that integrates fields of electrical engineering and computer science required to develop computer systems combining hardware, software or firmware. Computer engineers generally have training in electronic engineering or electrical engineering, software design, and hardware-software integration instead of only software engineering or electronic engineering. Computer engineers are involved in many hardware and software aspects of computing, from the design of individual microcontrollers, microprocessors, personal computers, and supercomputers, to circuit design. This field of engineering not only focuses on how computer systems themselves work, but also how they integrate into the larger whole.

Usual tasks involving computer engineers include writing software and firmware for embedded microcontrollers, designing VLSI chips, designing sensors or mixed signal circuit boards, and designing operating systems. Computer engineers are also suited for robotics research which relies on using digital systems to control and monitor electrical systems like motors, communications, and sensors.

Computer Engineering students are allowed to choose areas of in-depth study early on because the full breadth of knowledge is used in the design and application of computer engineering systems.

Both graduate programs require individual curriculum.

The graduates of these programs will be able to meet the highest standards of training for leadership in the computer science and computer engineering professions, including research, teaching, and high technology industry and R&D organizations. FCSE strongly supports the idea of using modern equipment and technologies to enhance the knowledge and learning capabilities of the students and to provide them with a stimulating and challenging environment essential for high quality education. Emphasis is laid on the innovative and practical applications of computer science and computer engineering to the software and hardware needs of the global society and industry in general and Pakistani society and industry in particular. Alongside the research activities for academic pursuits, the faculty of FCSE is actively involved in collaborative research and consultancy work with the local industry and R&D organizations and frequently invites speakers from these organizations. The summer internship of the undergraduate students in industry has added strength to such linkages.

Development of techniques that can ultimately be incorporated into a computing system to make it more efficient and available for a large class of users is a matter of principal concern to the computer scientists and engineers. Such developments need to be supported by effective usage of suitable hardware. The graduate programs of the FCSE addressed these concerns with a focus on the following research areas.

The graduate program at the FCSE may be pursued with a specialization theme, depending upon the research interests of the available faculty, in one of the following areas:

I. Artificial Intelligence and Robotics
ii. Algorithms and Computational Theory
iii. High performance computing
iv. Machine Learning & Data Mining
v. Network Communication and Distributed Systems
vi. Signal and Image Processing and Computer Vision
vii. Software and Systems Engineering

The FCSE offers courses leading to both Masters (MS) and Doctor of Philosophy (PhD) degrees in Computer

Science and Computer Engineering.

COURSE WORK:

MS Degrees

The courses offered by the FCSE are categorized as core courses, faculty and inter-faculty electives. An MS student, specializing in any area, will be required to take core courses (3 out of 4 for CE, & 4 for CS), take two courses from respective required electives, and a minimum of two courses from one of the areas of concentration. The remaining courses are electives and can be selected from the faculty elective courses or from those offered by other faculties.

PhD degrees

The courses to be taken up by a student will be decided by the student's PhD Guidance Committee and approved by the Dean of Graduate School. Out of Six courses, at least four must be from the list of FCSE courses and the remainder from other faculties.

List of Courses:

Core Courses for Computer Engineering

Code	Course Code
CSE501	Advanced Algorithms and Computational Techniques
CSE503	Advanced Operating Systems
CSE504	Advanced Computer Architecture
CSE602	Probability and Stochastic Processes

Required Elective Courses for Computer Engineering*

Code	Course Code
CSE521	Queuing Theory/Network II
CSE522	Mobile and Wireless Networks
CSE525	Parallel and Distributed Computing
CSE527	Routing and Switching
CSE532	Signal and Image Processing
CSE533	Pattern Recognition/VR based Systems
CSE638	Analysis of Stochastic Processes
CSE539	Robotic Vision

Core Courses for Computer Science

Code	Course Code
CSE501	Advanced Algorithms and Computational Techniques
CSE511	Advanced Theory of Computation

Required Elective Courses for Computer Science*

Code	Course Code
CSE542	Software Testing and Reliability
CSE553	Data Mining
CSE562	Advanced Artificial Intelligence
CSE571	Graph Theory
CSE632	Machine Learning
CSE661	Machine Learning& Computer Vision
CSE662	Deep Learning

*Current list is available with the FCSE faculty.

Software System Engineering

Code	Course Code
CSE517	Semantic Web
CSE518	Web Engineering
CSE541	Advanced Software Engineering
CSE542	Software Testing and Reliability
CSE543	Advanced Software Quality Assurance
CSE546	Advanced Human Computer Interaction
CSE547	Formal Methods in Software Engineering
CSE549	Software Process Engineering
CSE550	Software Process Management and Improvement

Database Management and Data Mining

Code	Course Code
CSE551	Advanced Database Management Systems
CSE552	Multimedia and Hypermedia Systems
CSE553	Data Mining
CSE554	Big Data Analytics

Signal, Image Processing and Computer Vision

Code	Course Code
CSE532	Signal & Image Processing
CSE533	Pattern Recognition/VR based Systems
CSE534	Advanced Computer Graphics
CSE535	Advance Image Processing
CSE536	Medical Image Processing
CSE537	Multimedia Systems
CSE538	Computer Vision
CSE539	Robotic Vision
CSE632	Machine Learning
CSE633	Digital Image Watermarking
CSE681	Optical Computing

Networks Communication and High Performance Computing

Code	Course Code
CSE514	Advance Computer System
CSE520	Computer Security and IoT
CSE521	Queuing Theory/Computer Networks II

CSE522	Mobile and Wireless Networks
CSE523	Advanced Security and Forensics
CSE524	Multimedia Services Over IP Networks
CSE525	Parallel and Distributed Computing
CSE526	Cluster and Cloud Computing
CSE527	Routing and Switching
CSE528	High Performance Networks
CSE529	Mobile and Pervasive Computing

Artificial Intelligence and Scientific Computing

Code	Course Code
CSE561	Advanced Artificial Intelligence
CSE562	Advance Artificial Neural Networks
CSE563	Knowledge Engineering & Expert Systems
CSE564	Pattern Recognition
CSE565	Genetic Algorithms / Evolutionary Computation
CSE568	Information Retrieval and Query Processing
CSE571	Graph Theory
CSE572	Natural Language Processing
CSE573	Statistical Signal Image Processing
CSE574	Finite Element Methods
CSE660	Advance Numerical and Simulation Techniques
CSE661	Machine Learning and Computer Vision
CSE671	Analysis of Stochastic Processes

Theoretical Computing

Code	Course Code
CSE511	Theory of Automata II
CSE512	Compiler Construction
CSE513	Quantum Computing
CSE636	Advance Numerical and Simulation Techniques

Duration of the MS Program and semester wise workload:

The courses offered by the FCSE are categorized as core courses, faculty and inter-faculty electives. An MS (CE) student, specializing in any area, will be required to take three out of four core courses. An MS (CS) student will be required to take both core courses. A minimum of two courses from one of the areas of concentration is required as well, while completing the remaining credit hours. The remaining courses are elective and can be selected from the FCSE elective courses or from those offered by other faculties.

Course	Course Title
1st Semester	
CSxxx/CExxx	Core - 1
CSxxx/CExxx	Elective - I
CSxxx/CExxx	Elective - II
2ndSemester	
CSxxx/CExxx	Core - 2
CSxxx/CExxx	Elective - III
CSxxx/CExxx	Elective - IV
3rdSemester	
CSxxx/CExxx	Core - 3
CSxxx*/CExxx*	Core - 4/ Elective - V
CS599†/CE599†	Thesis - 1
4thSemester	
CS599†/CE599	Thesis

Duration of the PhD Program and semester wise workload:

The courses offered by the FCSE are categorized as core courses, faculty and inter-faculty electives. A PhD student, specializing in any area, will be required to take courses that PhD Guidance Committee decides and approved by the Dean of Graduate School. Out of eight at least five must be from the list of FCSE courses and the remaining courses may be from other faculties.

Course	Course Title
1st Semester	
CSE	Elective I
CSE	Elective II
CSE	Elective III
2ndSemester	
CSE	Elective IV
CSE	Elective V
CSE	Elective VI
3rdSemester	
CSE	Elective VII
CSE	Elective VIII
CSE	Thesis I
4thSemester	
CSE	Thesis II
5thSemester	
CSE	Thesis III
4thSemester	
CSE	Thesis IV

COURSE DESCRIPTIONS:

CSE 501 Advance Algorithms Analysis (3-0-3)
Probability and random variables, Complexity analysis of algorithms, NP hard and NP complete problems, approximate solutions, Various shapes of hashing, Graph Algorithms, Dynamic Programming, Randomized algorithms, Randomized online algorithms, adversaries. k-server, Linear Programming, Advance graph algorithms –I & II, Probabilistic algorithms e.g. Monte Carlo algorithms, Markov Chain models, Bayesian algorithms, Efficiency issues in algorithms, Streaming algorithms, Advanced topics in Algorithms

CSE 503 Advanced Operating System (3-0-3)
Introduction to various operating systems: UNIX/Linux, Windows/DOS, VMS, operating systems as resource managers, memory management, multi-programming, paging, segmentation, system programming in DOS and UNIX operating systems, distributed operating system, real time system.

CSE 504 Advanced Computer Architecture (3-0-3)
Von Neumann architecture instruction sect design, memory design and management methods: bank switching, indexed mapping, virtual memory, cache memory, RISC and CISC architectures, device and logical level I/O, multi processors, vector and array processors.

CSE 511 Theory of Automata-II/Advanced Theory of Computation (3-0-3)
Turing machines, decision problems, halting problems, NP-completeness (NP, NP-complete, NP-hard), Godel numbers, and advanced computability topics.

CSE 512 Compiler Construction (3-0-3)
Classification of languages and grammars, lexical analysis, deterministic, parsing techniques, symbol table processing, code generation, syntax directed compiling and global optimization.

CSE 513 Quantum Computing (3-0-3)
Real-time Applications and Computation Model, Architecture level analysis, Cache and Pipelining issues, Run time support, Priority Inversions, Common Design Patterns, Memory Management, Real Time Communication and Fault Tolerance, Real Time Kernels and Case studies

CSE 514 Advance Computer Systems (3-0-3)
Core concepts of computer systems, distributed, storage, and operating systems including Naming and Layering, Client/Server Communication, Time, Consistency, Big Data, Unstructured Cloud Infrastructure, Memory and thread management, automatic logging, recovery and replication.

CSE 517 Semantic Web (3-0-3)
Introduction to the Semantic Web, structured Web documents and resource description framework, programming with RDF/XML, Web ontology language: OWL, logic reasoning for the Semantic Web, programming with Ontology, Semantic Web applications.

CSE 518 Web Engineering (3-0-3)
The client-server model, HTTP, DNS, and SMTP application layer protocols, real-time data transmission and real-time transport protocol, network performance metrics, QoS (Quality of Service) over Internet, virtualization, IaaS, PaaS and SaaS models in cloud computing, Web browser and layout engines, HTML, HTML5 and HTML5 canvas, DOM, CSS and JavaScript; requirements for Web Apps, software architecture patterns for Web Apps; introduction to Python for Web Apps, Web2Py, Web Apps development framework, overview and MVC workflow, dispatching API, Web2Py objects, App Dev steps, blog, authentication and Appadmin, deploying Apps, configuring and version control.

CSE 520 Computer and IoT (3-0-3)
Computer security, overview of various branches of computing security, cybersecurity concepts, issues, and tools critical for solving problems in computing security, essential techniques to protect systems and network infrastructures, analyzing and monitoring potential threats and attacks, devising and implementing security solutions for organizations. Smart objects, IoT applications, and their enabling platforms, security attacks, changing operating and context conditions, compromising security components (e.g., local sensors, network components, application-level components), massive personal data use and potential legal breach and privacy.

CSE 521 Queuing Theory/Computer Networks-II (3-0-3)
Protocols (TCP/IP, UDP, ATM, Ethernet, etc.), backbone networks, distributed network architecture, local area

networks managing, wide area network, layered protocol, error corrections modems, multiplexes, packet simulation, and other advance topics.

CSE 522 Mobile and Wireless Networks (3-0-3)
Comprehensive coverage of the disciplines of mobile and wireless networking, with emphasis on architecture and protocols. Topics include cellular telephony, MAC algorithms, wireless PANs, LANs, MANs, WANs, wireless and mobile Internet, mobile ad hoc networking, mobility management, sensor networks, satellite networks, and ubiquitous computing.

CSE 523 Advanced Security and Forensic (3-0-3)
Students will learn cybersecurity concepts, issues, and tools that are critical in solving problems in the computing security domain. Topics include digital forensics, computer security, forensics data acquisition and analysis, advanced security countermeasures; networking administration and management, advanced digital forensics, cryptography, and cryptanalysis.

CSE 524 Multimedia Services Over IP Networks (3-0-3)
This course examines and explores recent advances in multimedia networking technologies. Major topics include multimedia compression and standards, quality of service (QoS) support mechanisms and protocols performance analysis, network calculus, IP multicasting, Internet multimedia applications, and multimedia transport over wireless networks.

CSE 525 Parallel and Distributed Computing (3-0-3)
Classification of computers, organization of data and parallel storage parallel computers, SIMD and MIMD architectures, parallel algorithms, multi-threading (POSIX C, Solaris L

CSE 526 Cluster and Cloud Computing (3-0-3)
Elements of parallel and distributed computing, cluster systems architecture, resource management and scheduling, single system image, parallel programming paradigms, cluster programming with MPI, cloud platforms, virtualization, cloud application programming models (task, thread, and MapReduce), cloud applications, "Big data" processing and analytics in distributed environments and future directions in utility and cloud computing.

CSE 527 Routing and Switching (3-0-3)
Basic switching concepts, operations of a router, routing tables, route lookup process, VLANs, dynamic

routing protocols, distance vector routing protocols, and linkstate routing protocols, static routing and default routing (RIP and RIPng), Open Shortest Path First (OSPF) network, Access Control Lists (ACLs) for IPv4 and IPv6 networks, dynamic host configuration protocol (DHCP) for IPv4 and IPv6 networks and network address translation (NAT) operations.

CSE 528 High Performance Networks (3-0-3)
Topic s include high-performance network architecture, control and signaling, high-speed wired, optical, wireless links fast packet, IP, optical switching, IP lookup, classification, scheduling, network processors, end system design protocol optimization, network interfaces, storage networks, end-to-end protocols, mechanisms and optimizations, high-bandwidth low-latency applications. Principles will be illustrated with many leading-edge and emerging protocols and architectures.

CSE 529 Mobile and Pervasive Computing (3-0-3)
computer and network architectures for pervasive computing, mobile computing mechanisms, human-computer interaction using speech and vision, pervasive software systems, location and context awareness , practical techniques for security and user-authentication, experimental pervasive computing systems, sensors that can capture and disseminate context information, sensing and actuation, embedding computing, security and privacy, spontaneous interaction of appliances and services with each other, ubiquitous data access

CSE532 Signal and Image Processing (3-0-3)
Introduction to signals and systems, LTI systems, Fourier analysis (CT/DT), Fourier transform (CTFT/DTFT/DFT), Laplace transform, z-transform analysis, sampling, fundamentals of DIP, image enhancement in spatial and frequency domain, image restoration,

CSE 533 Pattern Recognition/ Virtual Reality Based Systems (3-0-3)
Modelling techniques, drawing in 3D; graphics modelling techniques, issues in virtual environments,

sight, sound and haptic, CUCS, technical consideration for VR systems, interfacing with gloves and HMDS, applications, future directions.

CSE 534 Advanced Computer Graphics (3-0-3)
This course will cover major aspects of digital image generation, geometric modeling, computer animation, rendering, computer graphics principles, subdivision surfaces, real-time global illumination physically based animation, and 3D computer graphics.

CSE 535 Advanced Image Processing (3-0-3)
Image enhancement, image restoration, color image processing, wavelet techniques, image compression techniques, reconstruction of images, image segmentation: splitting, merging algorithms; concept of image recognition, image analysis, computer vision and 3-D image reconstruction.

CSE 538 Computer Vision (3-0-3)
Vision Tasks and Applications, Cameral Models and Image acquisition, Stereo Vision, Optical Flow, Motion Models in Computer Vision, Image Segmentation, Feature Detection and Matching, Recognition, 3D visualization, Visual Navigation and any other relevant topics in Computer Vision.

CSE 539 Robotic Vision (3-0-3)
The objective of this course is to provide the basic concepts and algorithms required to enable the mobile robots act autonomously in complex environments. The main emphasis of the course is to learn and understand the computer vision algorithms which would enable a robot to understand and analyze the environment in which it operates. The course starts with an introduction to the application of machine learning for robotic vision. The first half of the course builds up a background on the machine learning, starting from classical machine learning, going up all the way to deep specialized deep learning-based objection detection algorithms. The second half then focuses on the core concepts of computer vision such as perception, stereo vision and the basics of image processing and features extraction.

CSE 541 Advanced Software Engineering (3-0-3)
Formal methods: algebraic approach, verification, an introduction to Z language and formal specification; function point analysis, refactoring, cleanroom software engineering, component Software, re-engineering, architecture, software estimation, aspect-oriented programming, additional topics may be added.

CSE 542 Software Testing and Reliability (3-0-3)
Review of software engineering process; software testing, maintenance, software verification and validation, testing and debugging tools, software reliability, reliability growth modelling.

CSE 543 Advanced Software Quality Assurance (3-0-3)
Overview of SQA process control, standardization and management of SQA, software measurements; software static and dynamic analysis, statistical methods applied to SQA, SQA modelling and generation of metrics, software configuration methods.

CSE 546 Advanced Human Computer Interaction (3-0-3)
Development and use of models of interaction in the design and analysis of user interaction techniques Human factors, interaction elements, testing new methods of interaction and their utility through appropriate methods of empirical research, advanced methods for designing, prototyping, and evaluating user interfaces to computing applications, novel interface technology, adaptive interfaces, collaborative design issues, psychological and philosophical design considerations, and cultural and social issues.

CSE 551 Advanced Database Management Systems (3-0-3)
Comparison of various database techniques, Data model, theory of relation databases, SQL, query optimization, file allocation, indexing methods, transaction processing, recovery techniques, principles of distributed databases, concept of object-oriented databases.

CSE 552 Multimedia and Hypermedia Systems (3-0-3)
Data modelling of non-linear information (text, images, videos, sound gestures), impact of MM & HM systems hardware and software requirements, authoring systems, user interface designs, knowledge representation and navigation, multimedia database representations.

CSE 553 Big Data Mining (3-0-3)
Introduction to data mining, MapReduce, recommendation systems, search and near- neighbour search in high dimensional data, hashing and locality sensitive hashing (LSH), structure of the web graph, PageRank and project ideas, section on Map-Reduce infrastructure, link analysis, HITS and web spam, proximity on graphs, dimensionality reduction, clustering, mining data streams, large scale supervised machine learning, association rules, optimizing submodular functions, and mining the Web for structured data.

CSE 554 Big Data Analytics (3-0-3)
VSM model, data representation, data transformation and pre-processing, Search, Indexing and memory, natural Language Processing: data n-grams, Streams, Information and Language, analyzing Sentiment and Intent, Databases and their Evolution, Big data Technology and Trends, Map-Reduce, Big data analysis using Hadoop, data mining using mahout, classification, clustering, and mining, information extraction, deep learning from heterogeneous data, forecasting, data analysis: regression and feature selection, recent trends in big data.

CSE 561 Advanced Artificial Intelligence (3-0-3)
Introduction to artificial intelligence (AI), AI problems and applications, human intelligence vs machine intelligence, state-space search problem, heuristic search techniques, problem reduction representation, problem reduction search, knowledge representation techniques, concept of reasoning in AI, predicate logic, fuzzy logic, logical reasoning, genetic algorithms, machine learning.

CSE 562 Advanced Artificial Neural Networks (3-0-3)
Classification of computing techniques, basic neural network models, linear and non-linear separable problems, feed forward neural network models, feedback neural network models, single and multi-layer neural networks, learning strategies in computers, supervised and unsupervised neural network learning algorithms. Hebb net, Adaline and Madaline, back-propagation and variants, radial basis function networks, discrete and continuous Hopfield networks, counter-propagation learning algorithms, self-organizing maps, learning vector quantization, adaptive resonance theory, Boltzmann, Gaussian and Cauchy machines, neo-cognition and recent trends in neural networks.

CSE 563 Knowledge Engineering & Expert Systems (3-0-3)
AI Techniques used in knowledge representation and engineering, knowledge representation models for understanding and problem solving, knowledge organization, representation of episodes, question answering, reconstruction memory planning, inference mechanisms, knowledge acquisition models, expert and decision support (DS) systems: design issues, expert system development, constructive problem solving, blackboard architectures, case studies.

CSE 564 Pattern Recognition (3-0-3)
Introduction to pattern recognition, applications of pattern recognition: Hand-written character recognition, speech and image processing, syntactic and statistical approaches to pattern recognition, neural network, images, etc.

CSE 565 Genetic Algorithms/Evolutionary Computations (3-0-3)
Introduction to genetic algorithms, Genetic algorithms: Biological inspiration, the canonical genetic algorithm (GA), variants of GAs and the schema theorem, hybrid GAs, evolutionary strategies and evolutionary robotics, genetic programming (GP), GP theory, multi-objective optimisation, GA pragmatics, ant colony optimisation, particle swarms, differential Evolution, meta-heuristics, and DNA computing, membrane computing.

CSE 571 Graph Theory (3-0-3)
Introduction: history, basic definitions of graph, path and circuits; isomorphism, trees: properties, spanning trees, algorithms for shortest spanning trees; matrix representation of graphs; directed graphs (diagraphs); matrices of diagraphs;. planar graphs; applications of graph theory: switching and coding, electrical networks analysis; maximum flow problem, shortest path algorithms, operational researches, Markov's processes.

CSE 572 Natural Language Processing (3-0-3)
Simple word vector representations, advanced word representation (N-gram Language Models), part of speech tagging and sequence labeling (e.g., using

Markov models), LSTM recurrent neural networks, neural networks for NLP: named entity recognition, parsing, and language modelling, semantic analysis, information computations, breaking RSA encryption with extraction, machine translation.

CSE 573 Statistical Signal/Image Processing (3-0-3)
Basic probability and random variables, random vectors and processes, statistical models, convergence and limit theorems, expectation and averages, independent and identically distributed random variables, independent increment, Markov, and Gaussian random processes, stationary random processes;, autocorrelation, power spectral density, mean square error estimation, detection, and linear estimation.

CSE 574 Finite Element Methods (3-0-3)
Formulations for 1D, 2D and 3D stress problems, formulations for heat transfer and fluid mechanics problems strong form, weak form and Galerkin method, interpolation functions for various elements Iso-parametric elements, stiffness matrix and load vectors, numerical integration methods, convergence criterion, analysis of finite element analysis results, structure of a finite element program.

CSE 581 Advanced Digital Communication/Quantum Computing (3-0-3)
Fundamentals of Cbits and Qbits, quantum computations, breaking RSA encryption with quantum computers, searching with a quantum computer, quantum error correction, quantum cryptography, quantum teleportation, quantum dense-coding, quantum circuits; simulation of a simple quantum computer.

CSE 602 Probability and Stochastic Processes (3-0-3)
Random variables, expectation, conditional distribution and expectation, stochastic processes (Bernoulli processes, Poisson processes, renewal processes), discrete-time Markov chains, continuous-time Markov chains, and other advance topics.

CSE 633 Digital Image Watermarking (3-0-3)
History and basic principles of watermarking, applications, properties and benchmark, human visual system, color transformations, discrete frequency transformations, communications systems, communications based models of watermarking, principles of spread spectrum communications, current trends in watermarking.

CSE632 Machine Learning (3-0-3)
Supervised Learning, Discriminative Algorithms, Generative Algorithms, Support Vector Machines, Learning Theory, Online Learning and the Perceptron Algorithm, Unsupervised Learning, Mixture models, Factor Analysis, Principal Components Analysis, Independent Components Analysis, advanced topics in ML.

CSE636 Advanced Numerical and Simulation Techniques (3-0-3)
Taylor series, Finite difference, Truncation error, Euler method, Implicit methods: Backward Euler, Richardson extrapolation, Crank-Nicholson, Multistep methods: Adams-Bashforth and Adams-Moulton Methods, Stability, Predictor-corrector methods, Improved Euler method, Runge-Kutta methods, Finite Difference Method, Finite Element Method (Continuous and Discontinuous Finite Elements) and Wavelets for the solution of Partial Differential Equations.

CSE 637 Data Authentication Techniques (3-0-3)
Introduction to data authentication, image authentication framework, applications of data authentication, spatial versus frequency domain authentication, signature generation and verification, public and private key issues, features of fragile marking systems, attacks on fragile marks.

CSE638 Analysis of Stochastic Processes (3-0-3)
Random variables, Expectation, Conditional distribution and expectation, Stochastic processes (Bernoulli processes, Poisson processes, Renewal processes), Discrete-time Markov chains, Continuous-time Markov chains, and other advanced topics.

CSE 660 Advanced Numerical and Simulation Techniques (3-0-3)
Topics covered are: the mathematical and computational foundations of the numerical approximation and solution of scientific problems,

simple optimization, vectorization, clustering, polynomial and spline interpolation; pattern recognition, integration and differentiation, solution of large scale systems of linear and nonlinear equations, modelling and solution with sparse equations, explicit schemes to solve ordinary differential equations, random numbers stochastic system simulation.

CSE 661 Machine Learning and Computer Vision (3-0-3)
The objective of this course is to study the applications of machine learning in the field of computer vision. The course is divided into three parts. The first part of the course gradually builds up a background on the machine learning. The second part of the course covers the fundamentals of computer vision, such as 3D-scene-to-2D-image transformation (camera model), an introduction to image processing (convolution & filtering) as well as classical feature extraction pipeline. The final part of the course then builds up on the machine learning and computer vision concepts learnt earlier in the course by studying and applying state-of-the-art deep learning algorithms on a variety of computer vision problems, such as object detection, image augmentation, time series data, etc.

CSE 662 Deep Learning (3-0-3)
Build and train neural network architectures such as Convolutional Neural Networks, Recurrent Neural Networks, LSTMs, Transformers, and learn how to make them better with strategies such as Dropout, BatchNorm, Xavier/He initialization, and more. Theoretical concepts and their industry applications using Python and TensorFlow to tackle real-world cases such as speech recognition, music synthesis, chatbots, machine translation, and natural language processing.

CSE 671 Analysis of Stochastic Processes (3-0-3)
Taylor series, finite difference, truncation error, Euler method; implicit methods: backward Euler, Richardson extrapolation, Crank-Nicholson; multistep methods: Adams-Bashforth and Adams-Moulton methods, stability, predictor-corrector methods, improved Euler method, Runge-Kutta methods, finite difference method, finite element method (continuous and discontinuous finite elements) and wavelets for the solution of Partial Differential Equations.

CSE 681 Optical Computing (3-0-3)
Basic theory of diffraction, lenses, the fast Fourier transform, optical memory, optical signal processing, computer-generated holograms; optical implementation of neural networks and other advance topics.

CSE 590/690: Special Topics in Computer Science (3-0-3)
The Computer Science program offers "Special topics," only occasionally on topics of current interest. The selection of a topic is different every semester. Special Topics courses do not repeat material presented by regular semester courses.

CSE 591/691: Special Topics in Computer Engineering (3-0-3)
The Computer Engineering program offers "Special topics," only occasionally on topics of current interest. The selection of a topic is different every semester. Special Topics courses do not repeat material presented by regular semester courses.

CSE 598 Master Project Report (6)
CSE 599 Master Thesis (9)
CSE 699 Ph.D. Dissertation (18)

Research and Labs Facilities

Instructional, Research and Project Laboratories

The Faculty of Computer Science and Engineering is well equipped with state- of-the-art computer systems running a wide range of applications and specialized software supporting the courses. In addition, well-equipped research laboratories are available for the use of faculty, graduate students, and senior undergraduate students. The following is a brief description of various laboratories and their functions.

a. Programming and Computing (PC) Lab

The Programming and Computing (PC) laboratory is the central computing laboratory of the Institute, providing general purpose computing facilities to all students, as well as internet and printing facilities. It is open seven days a week from early morning till late at night. It houses 100+ Core-i3/i5 networked machines running Windows as well as Linux operating systems. DSL - WiFi facilities are also available. Introduction to Computing and Intensive Programming lab modules are conducted in this lab. Student workshops and software competitions are also held in this laboratory.

b. Software Engineering (SE) Lab

The Software Engineering (SE) laboratory focuses on providing facilities for courses such as Software Engineering, Language and Compilation Techniques, and Databases. It houses 55 networked Core-i7 machines. They are connected to database and other servers of the Institute, including the printing facilities. In addition, DSL-WiFi facilities and various software tools (e.g., Eclipse, Visual Studio, Flex, Bison, Oracle/Developer and Rational Rose) are also available in this lab. This laboratory also hosts student workshops and software competitions.

c. Operating Systems and Networking (OSN) Lab

The Operating Systems and Networking (OSN) laboratory is used mainly for lab modules for Operating Systems, Computer Communications and Networking and Systems Programming courses. This lab is equipped with 90 machines running various operating systems and network simulation software tools, e.g., DEV C++, MATLAB, Prolog, Oracle 11G + Wamp Server, Cisco Packet Tracer and other software tools.

d. Data Structure and Algorithms (DSA) Lab

The Project and Software Development (PSD) laboratory is used for coding and simulating problems related to both academia and industry. This lab is primarily used for lab sessions for students of Data Structures and Signals as well as for conducting workshops and events organized by faculty members and different societies at GIK Institute. It is equipped with 50 Core-i5 workstation running window 7 professional, Visual Studio 2012, MATLAB, Packet Tracer and other software tools.

e. High-Performance Computing (HPC) Facility

High-Performance Computing (HPC) facility was established in Faculty of Computer Science and Engineering in 2006, using an AMD Opteron-based computing cluster. This facility has been upgraded using 10 million rupees funds from Directorate of Science and Technology (DoST), Government of Khyber Pakhtunkhwa. The facility consists of 160 CPU cores, 1024 GPU cores, 640 GB main memory and 10 GB Ethernet switch interconnection.

f. Artificial Intelligence Computing (AIC) Lab

The Artificial Intelligence Computing (AIC) laboratory is the main computing facility for AI-specific lab and research tasks. It houses 55 state-of-the-art networked iMac machines with M1 processor, SSD hard disks, and 16 GB RAM. In addition, this lab is connected to high-speed computing servers with additional memory and GPU support. The lab modules of various AI courses, e.g., those of Deep Neural Networks, Operating Systems, Computer Vision, Machine Learning, and Natural Language Processing are conducted in this lab.

g. Aerial Robotics and Vision Lab

The Innovaion (Inova) laboratory is the project facility for AI-specific and Data-Science project tasks. It houses several project tools and equipment like programmable drones, programmable robots, programmable toy cars,oculus, and EEG machines. In addition, this lab contains 15 high performance computing machines with additional memory and GPU support for projects of various courses and Senior Year Design Projects for AI and DS students. The lab will also be used for conducting industrial training labs and Problem Based Learning for AI (PBL for AI) and Problem Based Learning for DS (PBL for DS) labs.

h. Data Analytics (DA) Lab

The Data Science Computing (DSC) laboratory is the main computing facility for DS-specific lab and research tasks. It houses 55 state-of- the-art Core-i7 networked All-in-One Ultra PC machines. In addition, this lab contains 10 high speed computing servers with additional memory and GPU support. Lab modules of Big Data Analytics, Data Mining, Data Visualization, and Data Warehousing and Business Intelligence are conducted in this lab.

Research Groups

1-Heterogeneous Extreme Computing (HEX) Group

Modern Deep Learning (DL) data loads come with immense computational needs and require extreme computing models that can capture the parallelism in the underlying DL algorithms and can utilize the processing capabilities of the compute resources to efficiently exploit the parallelism. The compute architecture for such workloads usually is heterogeneous in nature. GPUs are used traditionally as co-processors in such systems along with multi-core CPUs to accelerate compute-intensive parts of the DL algorithms. FPGAs are now also quickly gaining traction as competitors due to their advantages in terms of computation/watt. The aim of this group is to conduct research and training workshops targeted towards the development of innovative solutions with a focus on extreme computing and heterogeneous systems for the acceleration of data-intensive DL workloads.

Research Team:

Dr. Fahad Bin Muslim (Head)
Dr. Waqar Ahmad
Dr. Masroor Hussain
Dr. Muhammad Irfan (FEE)
Dr. Muhammad Usman
Mr. Said Nabi
Engr. Abu Bakr
Engr. Irfanullah

International Collaboration:

King Abdulaziz University (KAU), Saudi Arabia.
Birla Institute of Engineering Technology, India.
Ulster University, Belfast, United Kingdom
Barcelona Supercomputing Center, Spain
Incheon National University, South Korea
Florida International University, USA
International Collegiate Programming Contest (ICPC)

Industrial Collaboration:

ATS, Islamabad
Innovation Lab, Faisalabad
Nescom, Islamabad

2-Data Engineering, Management and Analysis (DEMA) Group

The Data Engineering Management and Analysis (DEMA) Group is a team of professionals focused on optimizing data engineering, management, and analytics. Design of robust data architectures, supervise comprehensive data governance, derive actionable insights using advanced analytics, and maintain coordination with stakeholders to facilitate informed decision-making. The DEMA Group ensures that organizations can transform unstructured data into strategic, value-driven insights by continuously innovating and providing training.

Research Team:

Dr. Masroor Hussain (Head)
Dr. Muhammad Usman
Dr. Farhan Khan
Ms. Abinta Mehmood
Mr. Talha Laique
Mr. Ehtisham Hassan

Ms. Iffat Maab
Ms. Nazia Shahzadi
Ms. Asima Sarwar
Mr. Muneeb Baig

International Collaboration:
The University of Tokyo, Japan
Austrian Institute of Technology, Austria
Carinthia University of Applied Sciences, Austria
Harbin Engineering University, China
International Collegiate
Florida International University, USA

Industrial Collaboration:
Careem
KPCTA
Rawalpindi Institute of Cardiology
GeniTeam
Uworx

3-Telecommunications and Networking (TeleCoN) Research Group

The Telecommunications and Networking (TeleCoN) Lab is an inter-faculty Research Canter jointly established by the Faculty of Computer Sciences & Engineering and the Faculty of Electrical Engineering. The Executive Committee of SOPREST and GIK Institute in its 62nd meeting, held on 26th July 2017, accorded approval to establish the TeleCoN Research Center. The TeleCoN Research Center seeks to foster high-quality research focused on the design and analysis of communication systems and network architectures and protocols that are cost effective, scalable and meet the emerging needs for high-performance, high-capacity and reliable communications. The TeleCoN Research Group promotes fundamental and applied research employing cutting-edge networking, communication and signal processing techniques and technologies. General areas of interest of the TeleCoN Research Group include resource allocation, traffic management, tele-traffic engineering, security, energy efficiency, cooperative communications and quality of service in Internet, wireless sensor networks, mobile ad hoc and vehicular networks, cognitive radio networks, multi-user relay networks and 5G heterogeneous cellular networks. Other activities of the center include the organization and co-organization of seminars, workshops, lectures, trainings and invited talks to consolidate the educational and research work and to promote the objectives of the group. Since its inception in 2017, the TeleCoN Research Center has produced over 110 research articles, including 85 articles in impact factor journals. Additionally, the center has produced 12 PhDs who are well-placed as assistant professors in renowned universities in the country and as post-doctoral researchers in Canada and South Korea. Moreover, the canter has produced 14 MS graduates who are well-placed in industry and academia in the country and pursuing PhD in France, Norway, Switzerland and England.

Research Team:
Dr. Ghulam Abbas, FCSE (Head)
Dr. Ziaul Haq Abbas, FEE,
Dr. Ahmad Kamal Hassan, FEE
Dr. Zaiwar Ali, FEE

International Collaboration:
Dr. Lei Jiao, University of Agder, Norway.
Prof. Dr. Thar Baker, University of Brighton, UK.
Prof. Dr. Zhu Han, University of Houston, Houston, Texas, USA.

Industrial Collaboration:
Huawei Pakistan

4-Aerial Robotics and Vision Research Group

The Aerial Robotics Lab at FCSE, GIK institute aspires to develop novel systems which would induce intelligence in flying robots for autonomous flights, with different applications. The mission of the lab is to develop and employ state of the art machine learning and computer vision algorithms to solve all kinds of vision related problems, with applications in aerial surveillance and monitoring, aerial mapping, precision agriculture, aerial mapping, target tracking and analysis, orthographic survey, medical image processing and many more. Our ultimate goal is to design and implement advanced, networked embedded systems, to enable autonomous flights that can perform centralized or decentralized navigation, and group decision-making through principles of intelligent flight algorithms. We take inspiration from nature, where these systems abound, and translate biological mechanisms and principles into innovative applications.

Research Team:
Dr. Ahmar Rashid (Head of the Lab)
Dr. Asif Khan (Founding Member)
Dr. Muhammad Hanif (Co-Lead)
Dr. Farhan Khan (Core Member)
Dr. Khurram Jadoon (Core Member)
Dr. Kamran Khan (Core Member)
International Collaborations:
Kutahya University, Turkey

Industrial Collaborations:
Aga Khan University
Cybrid Tech

5-Biomedical Informatics Research Group (BIRG)

The Biomedical Informatics Research Group is a dynamic and innovative team dedicated to advancing the field of biomedical informatics. Comprised of multidisciplinary experts including bioinformaticians, data scientists, medical professionals, and computer scientists, this group collaborates at the intersection of healthcare, technology, and data analysis. Their mission is to leverage cutting-edge computational techniques and data-driven methodologies to solve critical healthcare challenges. Whether it's developing predictive models for disease diagnosis, optimizing electronic health record systems, or conducting research on personalized medicine, the Biomedical Informatics Research Group is at the forefront of harnessing the power of data to improve patient care and drive advancements in the medical field. Their work has the potential to revolutionize healthcare delivery and significantly impact the quality of healthcare worldwide.

Research Team:
Dr. Shahab Ansari (Head)
Dr. Raja Hashim
Dr. Khurram Jadoon
Mr. Khurram Shehzad
International Collaborations:
Pompeu Fabra University (Spain)
University of Derby (Britain)
University of South Florida (USA)
Industrial Collaborations:
Aga Khan Hospital, Karachi
Dr. Akbar Niazi Teaching Hospital, Islamabad
PCSIR, Karachi

6-The Machine Intelligence Research Group (MInG)

The Machine Intelligence Research Group (MInG), is an active research group currently based in the Faculty of Computer Science and Engineering of the Ghulam Ishaq Khan Institute of Engineering Sciences and Technology,

Topi. The group was initially established in the year 2006, providing a platform for bringing together faculty members and students interested in conducting cutting edge research in the following areas: Artificial Intelligence, Machine Learning, Computational Intelligence, Data Mining & Knowledge Discovery, Affective Computing, and Intelligent Transportation Systems The group has so far successfully produced nine Ph.D. graduates and more than 40 MS scholars. All of them working in various national and international organizations. MInG strives to provide a platform to the research where fresh scholars get the opportunity to learn and groom themselves under the supervision of experienced computer scientists. Current focus of the group in on topic relating (but not limited to): Data Science, Machine Learning, Computational Intelligence, Affective Computing, Bioinformatics, and Intelligent Transportation Systems.

Research Team:
Prof. Dr. Zahid Halim (Group Head)
Dr. Salman Ahmed
Dr. Raja Hashim Ali
Dr. Taj Muhammad Khan
Dr. Khurram Khan Jadoon
Dr. Ali Imran Sandhu
Mr. Ahsan Shah
Mr. Muhammad Sajid Ali
Mr. Talha Laique
Ms. Beenish Urooj
Mr. Qasim Riaz

International Collaboration:
Université Sorbonne Paris Nord, Laboratoire d'Informatique de Paris-Nord (LIPN), France
Dumlupinar University, Turkey
Izmir Democracy University, Turkey
Inria, France
University of Florence, Italy

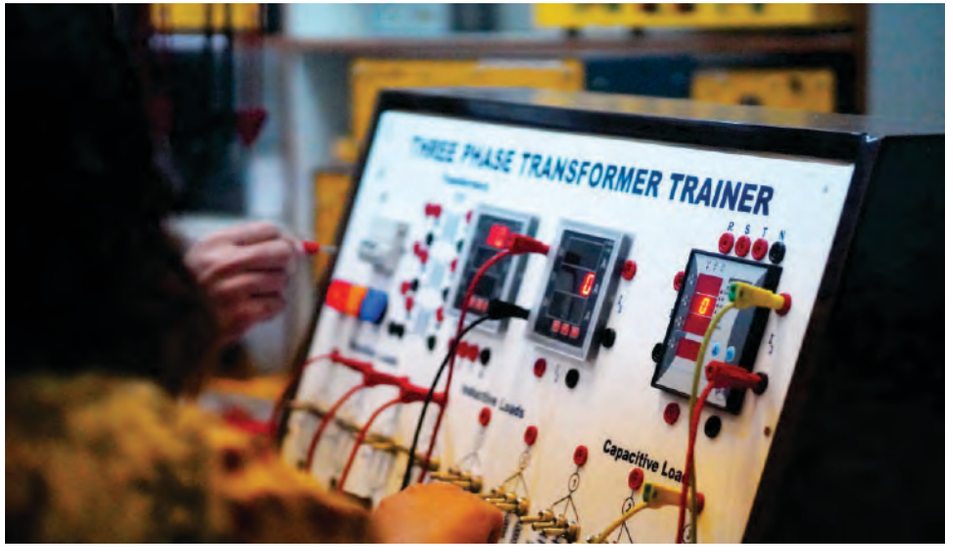
Industrial Collaboration:
Techlogix Pakistan (Pvt) Ltd
Confiz technologies
Pakistan Air Force

FACULTY OF ELECTRICAL ENGINEERING

Dean
Muhammad Akbar
PhD, University of Tokyo, Japan

FACULTY

Nisar Ahmed,	**PhD, ICSTM, London, UK**
Khasan Karimov,	**PhD, S. Petersburg, Russia**
Zia-ul-Haq Abbas,	**PhD, University of Agder, Norway**
Arbab Abdur Rahim	**PhD, Politecnico di Torino, Italy**
Hadeed Ahmed Sher	**PhD, King Saud University, KSA**
Adnan Noor	**PhD, University of Manchester, UK**
Dur-e-Zehra Baig	**PhD, UNSW, Sydney, Australia**
Husnul Maab	**PhD, QAU, Islamabad, Pakistan**
Shahid Alam	**PhD, Chalmers University of Technology, Sweden**
Ahmad Kamal Hassan	**PhD, King Abdulaziz University, KSA**
Memoon Sajid	**PhD, Jeju National University, South Korea**
Ammar Arshad	**PhD, Aalto University, Finland**
Waleed Tariq Sethi	**PhD, University of Rennes1, France**
Attique Ur Rehman	**PhD, Auckland University of Technology, New Zealand**
Muhammad Irfan	**PhD, City University of Hong Kong, Hong Kong**
Zaiwar Ali	**PhD, GIK Institute, Pakistan**
Mazhar Javed	**MPhil, QAU, Islamabad, Pakistan**
Muhammad Umar Afzaal	**MS, UET Taxila, Pakistan**



Introduction:

The explosive growth in the area of electrical engineering during the past two decades has impacted almost every facade of human life. Developments in signal processing, digital electronics and wireless communication have heralded the age of information technology. Sophisticated digital hardware combined with novel control and signal processing algorithms have directly contributed to the landing of probes on distant planets as well as efficient operation of massive industrial units. Advances in electrical engineering are allowing us on one hand, to monitor crop growth from satellites, predict weather disturbance worldwide and control nuclear power plants remotely, while on the other hand, are making advanced technology readily accessible to the common man through advances in bio-medical engineering and personal communication systems.

The rapid pace of development of technology in the modern world has blurred the traditional boundaries of the field of electrical engineering. It is not clear anymore where electrical engineering stops, and another discipline starts. Automobile engineering has been the traditional domain of mechanical engineering, yet state-of-the-art electronics is at the heart of ultra-low emission vehicular technology. Electronics drives the modern artificial heart, and surface emitting lasers are invading computers. Agriculturists monitor growth, and satellites map the earth providing a detailed view of crop distribution, soil erosion conditions and deforestation.

The program in Electrical Engineering has been developed to cater to these diverse needs of industry. The GIK Institute is an integrated institute and the programs of study in Electrical Engineering have been developed to allow students to take courses in all the different disciplines available here. The Faculty of Electrical Engineering (FEE) offers courses leading to both Master of Science (MS) and Doctor of Philosophy (PhD) degrees in Electrical Engineering. Presently, FEE offers the following four graduate programs:

I. MS in Electrical Engineering
II. MS in Electronics Engineering
III. PhD in Electrical Engineering
IV. PhD in Electronics Engineering

Graduate program can be pursued in FEE with specialization in one of the following three areas: Power and Control System, Communication and Digital Signal Processing, and Microelectronics, MEMS and ASIC Design.

COURSE WORK:

MS Degree

The courses offered by the FEE are categorized as core courses, faculty and inter-faculty electives. An MS student, specializing in any area, will be required to take all the core courses and minimum two courses from his/her choice of the area of concentration. The remaining courses are elective and can be selected from elective courses offered by FEE and other faculties.

PHD Degree

The courses to be taken by the student will be decided by the student's Ph.D. guidance committee and approved by the Dean of the Faculty. Out of six courses, four must be from the list of FEE courses, and the remainder could be from other faculties

LIST OF COURSES CORE COURSES

EE501	Linear Systems Theory
EE502	Stochastic Processes
EE503/EE541*	Microwave Engineering

*** Core only for MS in Electronics Engineering**

AREA OF CONCENTRATION
Power and Control Systems

EE511	Transmission and Distribution of Electric Energy
EE512	Computational Methods for Power System Analysis
EE513	Power Converters, Design Control and Applications
EE514	Power Semiconductor Devices
EE515	Adjustable Speed Drives
EE516	Transients in Power Systems
EE517	Distribution System Modeling and Analysis
EE518	Advanced High Voltage Engineering
EE519	Advanced Concepts in Power System Protection
EE521	Switch Mode Power Supplies
EE531	Digital Control Systems
EE532	Nonlinear Control Systems
EE533	Optimal Control and Estimation
EE534	Intelligent Control Systems
EE535	Adaptive Control
EE611	Dynamics and Control of Integrated Power System
EE612	Optimization and Economics of Integrated Power Systems
EE613	Power System Quality
EE614	Smart Grids
EE617	Power System Planning
EE618	High Voltage Technology
EE621	Power processing for Photovoltaic systems
EE631	Advanced Continuous Time Control Systems Design
EE632	Robust Control of Uncertain Systems
EE633	Advanced Process Control
EE634	Navigation Guidance and Control
EE635	Model Order Reduction for Large Scale Systems

Communication and Digital Signal Processing

EE541/EE503	Microwave Engineering
EE542	Microwave and Photonic Devices
EE543	Antenna Design and Applications
EE544	Computational Electromagnetics
EE551	Digital Image Processing
EE552	Digital Signal Processing I
EE561	Advanced Digital Communications
EE563	Information Theory
EE641	High Frequency Electromagnetics
EE642	Electromagnetic Metamaterials
EE645	Photonic Sensors and Instrumentation
EE651	Remote Sensing
EE652	Digital Signal Processing II
EE653	Numerical Optimization
EE654	Applied Optimization: Tools and Modeling Techniques
EE655	Multirate Systems and Filter Banks
EE656	Advanced Multirate Filter Bank Theory and Its Applications
EE657	Theory of Wavelet Transform and its Applications
EE661	Mobile Cellular Telecommunication Systems
EE664	Performance Analysis of Computer and Communication Networks

Microelectronics and ASIC Design

EE571	ASIC Design
EE572	VLSI Design
EE573	Photovoltaic Energy and Its Applications
EE574	Semiconductor Device Processing and Technology
EE575	Electronics For Energy Control
EE576	MEMS Design and Micromachining
EE577	CISC Microprocessor System Design
EE578	Quantum Phenomena in Semiconductor
EE673	Advanced Computing Platforms
EE674	Organic Semiconductor and Devices

Special Courses

EE681	Special Topics in Electrical Engineering

EE501 - Linear Systems Theory (3-0-3)
Linear spaces and operators, state equation representation, transition matrix properties, internal stability, Lyapunov stability, controllability and observability, realizability and minimal realization, input-output stability, controller and observer forms, linear feedback and state observation, polynomial fraction description and application, geometric theory and application.

EE502 - Stochastic Processes (3-0-3)
Engineering applications of probability theory, problems on events, independence, random variables, distribution and density functions, expectations and characteristic functions, correlation and regression, multivariate Gaussian distribution, stochastic processes, stationarity, ergodicity, correlation functions, spectral densities, random inputs to linear systems, and Gaussian processes.

EE503/541 Microwave Engineering (3-0-3)
Review of general concepts (Maxwell's) equations, boundary conditions, energy flow, statics (Laplace's equation, Poisson's equation), distributed parameter systems (classification of solutions, transmission lines, and wave guides), radiation and antennas (arrays, reciprocity, Huygen's principle).

EE511 Transmission and Distribution of Electric Energy (3-0-3)
Important factors in the design and operation of the hardware necessary to deliver large amounts of electrical energy, reliability, over substantial areas, factors which limit power handling capability, line parameters and loss mechanisms, high voltage and current limitation in the form of corona, audible noise, radio noise, filed effects, and heat transfer.

EE512 Computational Methods for Power System Analysis (3-0-3)
Network model and matrices, three-phase networks, three-phase transformers, symmetrical components and other transformations, three-phase network matrices, fault, load flow studies, formulation and solution techniques, programming aspects, transformer and phase shifter representation, tie-line control, transient stability studies, machine equations, load and network representation.

EE513 Power Converters, Design Control and Applications (3-0-3)
Introduction to power electronics converters; AC/DC converters; uncontrolled rectifiers; thyristor-based phase controlled converters; PWM rectifiers; topologies and control; DC-to-DC converters; DC/AC single and multiphase converter topologies; multilevel converters; high power converters; applications including power supplies and motion control.

EE514 Power Semiconductor Devices (3-0-3)
Theory and construction of power switching devices; introduction and analysis in terms of switching and steady state characteristics, and possible application areas of power diode, power BJT, power MOSFET, thyristors, GTO, IGBT, MCT FCD, FCT, SIT and SIThy, MTO thyristor.

EE515 Adjustable Speed Drives (3-0-3)
Introduction to variable speed drive systems, characteristics of mechanical loads, requirements of electrical drive systems, basic principles of variable speed controls of DC motors and steady state analysis, methods of speed control, transfer functions of separately excited DC motors, single-phase and three-phase controlled rectifiers and chopper for DC motor drives, closed loop control of DC motors, single quadrant and four quadrants, steady-state analysis of induction motors, speed control of induction motors, e.g. variable terminal voltage control, variable frequency control, rotor resistance control, operation with a current source inverter, steady state analysis of synchronous motors, synchronous motor control.

EE516 Transients in Power Systems (3-0-3)
Transient in Power System: Definition, types of over-voltages, system earthing; Fundamental Notions of Electrical Transients; Simple Switching Transients: RL and RC transients, LC transients, RLC transients, trapped charge and magnification; Transient Excitation of First-Order Circuits: First order circuits, the Laplace transform method of solving differential equation; Transients in RLC Circuits: Transient circuit analysis, 2nd order differential equations; Modeling of Power Apparatus for Transient Analysis: Constant parameter transmission line and cable models, frequency dependent lines and cable models, transformer models, electric machines, surge arrestors, surge absorbers, surge divertors; Causes of Power System Over-Voltages; Surge Phenomena; Lightning Over-Voltages; Insulation Coordination; Travelling Waves and other Transients on Transmission Lines; Bewley Lattice Diagram for Transmission Line Transients; Transient Over-Voltage caused by Energization; Energization of composite feeder, temporary over-voltages in power system; Switchgear Duty and its Calculation: Transient Over-Voltages produced by Short-Line Faults.

EE517 Distribution System Modeling and Analysis (3-0-3)
Introduction to Distribution Systems: Typical components and topology, operations and policy, differences and similarities with transmission systems; Electric Loads: Definitions, characteristics, and uniform/nonuniform distribution models, static ZIP load modeling, three-phase induction machine; Unbalanced Distribution Line Segment Modeling: Series impedance and shunt admittance of overhead and underground lines, ground effects, exact and approximate line segment models; Three-phase System Component Modeling: Voltage regulators and feeder voltage regulation, three-phase transformer models, shunt capacitors; Unbalanced Distribution System Power Flow: Approximate method based on voltage drop, three-phase power flow analysis; Alternative Approaches: DistFlow and branch current flow; Special topics: Renewable integration, microgrids, substation protection and cyber-security, impacts of electric vehicles, enhanced load models and load control.

EE518 Advanced High Voltage Engineering (3-0-3)
Introduction to high voltage engineering, uses of high voltage in industry and research, high voltage AC,DC, and impulse generation, high voltage measurement techniques, high voltage insulation fundamental properties and practical applications, power loss in a dielectric, loss angle and dissipation factor, life-controlling parameters for insulation, electric breakdown of gases, liquids, and solids, high voltage apparatus for power systems, high voltage testing: philosophy, classification and test voltages, procedures of testing high voltage equipment, non-destructive high voltage tests, equipment short-circuit current endurance tests, overvoltage and insulation coordination, integrity of substations' grounding grid.

EE519 Advanced Concepts in Power System Protection (3-0-3)
Distance relaying and its response to unbalanced faults, Phase comparators, Power swing and power swing blocking, Load encroachment, Digital and numerical relays, Switchgear technologies, Arc theory and arc quenching techniques, Circuit breaker testing and quality, Inverse definite minimum time (IDMT) relays and their coordination.

EE521 Switch Mode Power Supplies (3-0-3)
Introduction to switching power supply, Buck converter, Boost converter, Buck-boost converter, Push pull converter, Single ended forward converter, Double ended forward converter, Flyback converter, bridge topology, housekeeping power supply, snubber circuit design, Control IC.

EE531 Digital Control Systems (3-0-3)
Z-plane analysis of discrete-time control system, design of discrete-time control systems by conventional methods, state space analysis, pole placement and observer design, polynomial equations approach to control system design, quadratic optimal control systems, digital estimation, stochastic control.

Ee532 Nonlinear Control Systems (3-0-3)
Introduction to nonlinear systems, phase plane analysis, stability determination by Lyapunov direct method, advanced stability theory, existence of Lyapunov functions, describing function analysis, nonlinear control system design by feedback, sliding control, variable structure control, adaptive control of linear and nonlinear systems, control of multi-input multi-out systems.

Ee533 Optimal Control and Estimation (3-0-3)
Review of state variable analysis, continuous-time optimal control, output feedback design, continuous controller redesign, digital controller implementation, direct design of digital controllers, frequency domain design techniques, state estimators, Kalman filtering, multivariable dynamic compensators.

EE534 Intelligent Control Systems (3-0-3)
Supervised learning and neural networks, back propagation, radial-base functions, associative memory and pattern recognition, self-organizing systems, fuzzy set theory, neuro-fuzzy logic controllers, neuro-fuzzy set theory, hybrid controllers, applications, implementation.

EE535 Adaptive Control (3-0-3)
Introduction to adaptive control, real-time parameter estimations, deterministic self-tuning regulators, stochastic and predictive self-tuning regulators, model-reference adaptive systems, properties of adaptive systems, stochastic adaptive control, auto-tuning, gain scheduling, robust and self-oscillating systems, practical issues and implementation, commercial products and applications, perspective on adaptive control.

EE542 Microwave and Photonic Devices (3-0-3)
MESFET description, second-order effects, AC behavior, MESFET design and usage, device modeling, MESFET noise, HEMT physical basis and structure submicron MOSFET, GUNN and IMPATT diodes, LED and semiconductor lasers, spontaneous and stimulated emission, heterostructure lasers, photo transistors.

EE543 Antenna Design and Applications (3-0-3)
Electricity small antennas, wire antennas and feeding arrangements, aperture antennas such as slots, horns and parabolic reflectors, antennas for multiple frequencies including log-periodic and other frequency independent types, receiving antennas and concept of antenna temperature, antenna measurements and evaluation.

EE544 – Computational Electromagnetics (3-0-3)
Introduction to electromagnetics, analytical methods, Methods include transfer matrix method, finite difference frequency-domain, finite-difference time-domain, beam propagation method, plane wave expansion method, rigorous coupled-wave analysis, method of lines, slice absorption method, finite element method, method of moments, and optimization.

EE551 Digital Image Processing (3-0-3)
Introduction to digital image processing techniques for enhancement, compression, restoration, reconstruction, and analysis, 2-D signals and systems, sampling and scanning, random fields, discrete Karhunen-Loewe transform, grayscale transformations, linear, ranked order, and morphological filters, human vision, printing and display of images, entropy-based compression, vector quantization, block truncation coding, transform coding, predicative coding, image degradation models, Wiener filter, constrained deconvolution, computed topography, edge detection, shape representation and segmentation.

EE552 Digital Signal Processing I (3-0-3)
Theory and algorithms for processing of deterministic and stochastic signals, discrete signals, systems, and transforms, linear filtering, fast Fourier transform, nonlinear filtering, spectrum estimation, linear prediction, adaptive filtering, array signal processing.

EE561 Advanced Digital Communications (3-0-3)
Analog message digitization, signal space representation of digital signals, binary and M-ary signaling methods, detection of binary and M-ary signals, comparisons of digital communication systems in terms of signal energy and signal bandwidth requirements, principal types of spread spectrum systems, applications of spread spectrum systems.

EE563 Information Theory (3-0-3)
Basic concepts of information theory, determination of channel capacity and its relation to actual communication systems, rate distortion theory, performance of various source codes.

EE571 ASIC Design (3-0-3)
Introduction to Application Specific Integrated Circuits (ASICs), design methodologies, design and implementation using FPGAs, digital design using hardware description languages such as Verilog HDL,

libraries, RTL level design of digital circuits, timing and delays, System-on- Chip (SoC), re-configurable computing.

EE572 VLSI Design (3-0-3)
CMOS devices and deep sub-micron manufacturing technology, CMOS inverters and complex gates, modeling of interconnect wires, optimization of design with respect to a number of metrics: cost, reliability, performance, and power dissipation, sequential circuits, timing considerations, clocking approaches, design of large system blocks including arithmetic, interconnect' memories, and PLA design methodologies.

EE573 Photovoltaic Energy and Its Applications (3-0-3)
Applications of solar energy, solar radiation, solar cell technology and properties, photovoltaic engineering, photovoltaic energy applications, environmental impact of photovoltaic, advanced and specialized topics, large PV projects, photovoltaic under concentrated sunlight, storage of energy (including alternative storage: the hydrogen economy), distribution of energy.

EE574 Semiconductor Device Processing and Technology (3-0-3)
Crystal growth and melt, epitaxial growth, oxide growth mechanism and kinetics, oxidation techniques and systems, oxidation induced defects, optical lithography, electron beam lithography, ion beam lithography, wet etching, RIE mechanism and techniques, diffusion mechanism in solids, diffusion enhancement and retardation, ion implantation and range theory, formation of shallow junctions by ion beam, metallization, GaAs device processing, measurements and characteristics of device parameters, VLSI process integration.

EE611 Dynamics and Control of Integrated Power System (3-0-3)
Modeling and simulation of synchronous and induction machines, transmission line dynamics and simulation, computer representation of excitation systems, governor and prime mover dynamics, interconnected system dynamics, theory of neglecting electromagnetic transients, time scale separation, transient stability studies, simulation methods, dynamic stability analysis, heroic measures for transient stability enhancement.

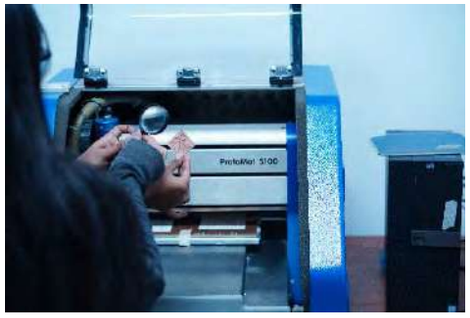
EE612 Optimization and Economics of Integrated Power Systems (3-0-3)
Relevant factors in power system operation, theory of optimization under equality and inequality constraints, computational methods, application to generation

scheduling in integrated power systems.

EE613 Power System Quality (3-0-3)
Power quality terms and definitions, voltage Sags and Interruptions, transient over voltages, fundamentals of harmonics, harmonic distortion evaluations, harmonic filter design, long-duration voltage variations, voltage flicker, power quality benchmarking, distributed generation and power quality, power quality monitoring and standards.

EE614 Smart Grids (3-0-3)
The Traditional Power Generation and Transmission System: Some Fundamentals to Overcome Challenges, Smart Grid, Renewable Energy Integration: Opportunities and Challenges, Energy Storage: Applications and Advantages Smart Meter, Demand Forecasting in Smart Grid, Database Systems for the Smart Grid, Securing the Smart Grid: A Machine Learning Approach, Smart Grid Communication and Networking Technologies: Recent Developments and Future Challenges, Economy of Smart Grid.

EE617 Power System Planning (3-0-3)
Review of Power System Planning Techniques; Review of Probability Concepts; Restructured Power System; Load Forecasting; Power System Reliability and Availability: Component, system, margin requirements, cost of interruptions, value based reliability analysis, transmission access impact, generation reliability, transmission reliability, and distribution reliability; Generation Planning: Engineering models, load forecast models, production costing, economic dispatch, pollution dispatch, reliability constraints, inventory management, least cost planning, and integrated utility planning; Bulk Power Transmission Planning: Engineering models, environmental constraints, reliability/security constraints, impact of



transmission access, and impact of third-party producers; Production Costing Analysis; Economic Evaluation of Projects in Power System Planning.

EE618 High Voltage Technology (3-0-3)
Overview of high voltage generation and measurement techniques, Important properties of dielectrics and their measurements, Maxwell equations and electrical fields in practical dielectric systems, Introduction to finite element based software Comsol Multiphysics, Gauss's law and field calculations in various electrode arrangements, Field grading/control techniques, Insulation materials and systems, Overview of gas discharge physics and electric breakdown in liquids and solids, Lightning and atmospheric over-voltages, Wave impedance and traveling waves, Fault detection in high voltage cables, Phenomena at interfaces in insulation systems (outdoor insulation and composite insulators), Diagnosis of insulation systems and measurement techniques, Insulators under multi-stressed conditions, Pollution flashover and insulation failure, Designing and numerical analysis of field (electric/magnetic) distribution in power system components including various types of insulation systems and suggestions for improvements of the design.

EE621 Power processing for Photovoltaic systems (3-0-3)
Introduction to Photovoltaics, Hardware setup of PV field, Effect of partial shading, Power processing architecture, MPPT algorithms, Grid synchronization, Battery selection

EE631 Advanced Continuous Time Control Systems Design (3-0-3)
Introduction to state space analysis of systems, controllability, observability, duality, minimal realization, modal control by pole placement methods, quadratic optimal control, design of observers, decoupling control, model following control, frequency domain analysis of multivariable systems, frequency domain design methods, estimation theory, Wiener filter, Kalman filter.

EE632 Robust Control of Uncertain Systems (3-0-3)
Function spaces and operator theory, basic concepts, uncertainty and robustness, structured singular value analysis, MU synthesis, stabilization, design constraints, loops shaping, model matching problem, stability margin optimization, design for robust performance, implementation.

EE633 Advanced Process Control (3-0-3)
Introduction to automatic control theory and structures, process systems and process models, process control of common unit processes, process control in large industrial complexes, robust processes control.

EE634 Navigation Guidance and Control (3-0-3)
Introduction, modern multivariable control analysis, modern filtering and estimation techniques, inertial navigation system, integrated INS, guidance laws, navigation and guidance filtering, advanced guidance system design.

EE635 Model Order Reduction for Large Scale Systems (3-0-3)
Introduction to model order reduction with motivating examples, tools from matrix theory for model approximation, survey of conventional model order reduction techniques, SVD based methods for approximation, Krylov based approximation methods and model order reduction, SVD-Krylov methods, Lyapunov and Riccati equations approximation, case studies.

EE641 High Frequency Electromagnetics (3-0-3)
Complex numbers and functions; conformal mapping; complex integration; power series; Taylor series; Laurent series; residue integration; approximate solution of linear differential equations; approximate solution of difference equations; asymptotic expansion of integrals; methods of stationary phases and steepest decent method; perturbation methods; basics of geometric theory of diffraction and uniform theory of diffraction.

EE642 Electromagnetic Metamaterials (3-0-3)
Introduction of meta materials, fundamentals of left handed meta materials, transmission line theory of meta materials, two-dimensional meta materials, guided-wave applications of meta materials, radiated-wave applications, future applications of meta materials.

EE645 Photonic Sensors and Instrumentation (3-0-3)
Introduction to photonic sensors and instrumentation, Basics of laser optics, Beam Shaping and Guiding, Laser Interferometry, Laser displacement and position sensors, Laser gyroscopes, Speckle Interferometry, Laser Doppler effect based sensors and instruments, Holographic interferometry, Laser spectroscopy, Optic Fiber sensors, Kerr and Faraday effect based sensors, Cherenkov radiation based particle detectors, Space Time curvature and gravitational wave detection using lasers, Infrared sensors, Optical Filters, Optical amplifiers, Locked-in Amplifier, p-i-n photodiode, APD (Avalanche Photodiode) Phototransistor, QWIP (Quantum Well Infra-Red Photo- detector), SEED (Self-Electro-optic Effect Device), Photomultiplier tubes, Bolometers, Josephen junction bolometers.

EE651 Remote Sensing (3-0-3)
concepts and methods of optical and microwave multispectral image generation and analysis; fundamentals of imaging sensor design and image analysis for complex scenes; applications of signal processing and signal design principles; statistical pattern recognition; spatial image processing; cartographic and geographic information systems techniques as appropriate to land scene data.

EE652 Digital Signal Processing II (3-0-3)
Statistical description of discrete and continuous signals, estimation and linear prediction theory, power spectrum analysis application to filtering interpolation, prediction problems, signal processing techniques extended to multidimensional physical systems and nonlinear systems.

EE653 Numerical Optimization (3-0-3)
Computer optimization techniques, unconstrained optimization, steepest descent or conjugate gradient method, Newton method, quasi Newton methods, Fibonacci and Golden search methods, constrained optimization, Lagrange multiplier, greedy methods, projection methods of linear programming.

EE654 Applied Optimization: Tools and Modeling Techniques (3-0-3)
Linear programming, Network Programming, Integer Programming, Stochastic Programming, Nonlinear Programming, Concepts of convexity, Steepest gradient descend method for solving convex optimization problems Applied optimization templates (LP, NP, IP, SP, NLP), commercial/open-source tools for solving these problems.

EE655 Multirate Systems and Filter Banks (3-0-3)
Introduction, review of discrete-time systems, review of digital filters, fundamentals of multirate systems, maximally decimated filter banks, paraunitary perfect reconstruction filter banks, linear phase perfect reconstruction QMF banks, cosine modulated filter banks, quantization effects, multirate filter bank theory and related topics, the wavelet transform and its relation to multirate filter bank, multidimensional multirate systems, multidimensional multirate systems, multivariable and lossless systems, paraunitary systems.

EE656 Advanced Multirate Filter Bank Theory and Its Applications (3-0-3)
Review of multirate signal processing, filter banks in wavelet analysis, properties of wavelets and wavelet analysis, multicarrier communication, wavelet packet based MCM techniques, discrete wavelet multitone, filtered multitone modulation for broadband fixed wireless systems, adaptive equalization in multirate filtered multitone, optimal channel equalization for filter bank transceivers, discrete multitone equalization techniques, MIMO biorthogonal partners: theory and applications, fractional biorthogonal partners and applications.

EE657 Theory of Wavelet Transform and its Applications (3-0-3)
Introduction of filters; down sampling and up sampling; filter banks; orthogonal filter banks; analysis and synthesis of signals; time-frequency analysis; the short-time Fourier transform; an orthogonal basis of functions; time-scale analysis; the continuous wavelet transform; comparison with STFT; examples of wavelets; analysis and synthesis with wavelets; the Haar wavelet; multiresolution analysis; the scaling function; discrete wavelet transform; filter banks and DWT; numerical complexity of DWT; cascade algorithm; designing wavelets; K-regular scaling filters; characterizing , Characterizing K-regular scaling filters; The Daubechies Maximally Flat Polynomial.

EE661 Mobile Cellular Telecommunication Systems (3-0-3)
Introduction to cellular mobile systems, elements of cellular radio system design, cell coverage for signal and traffic, cell-site antenna and mobile antenna, co-channel interference reduction, types of co-channel interference, frequency management, handoffs, operational techniques and technologies.

EE664 Performance Analysis of Computer and Communication Networks (3-0-3)
Poisson and exponential processes; discrete-time Markov Chains; Markov Chains at equilibrium;

reducible Markov Chains; periodic Markov Chains; discrete-time queues and queuing analysis; modeling of flow control protocols, error control protocols, and medium access control protocols using Markov Chains and queuing analysis; modeling techniques and performance analysis; modulated Poisson traffic models, scheduling algorithms; input buffer, output buffer, and shared buffer switches.

EE673 Advanced Computing Platforms (3-0-3)
Review of the basics of scalar pipelines in computer architectures; The concept of instruction level parallelism; Super-scalar pipelines; branch prediction and speculative execution; Memory hierarchy concepts and design; Multi-core processor and corresponding design issues; Power minimization using clock gating | power gating | heterogeneous processors/accelerators; Processor thermals and corresponding management/mitigation strategies.

EE674 Organic Semiconductor and Devices (3-0-3)
Organic semiconductors' technology, electric properties and applications, charge transport mechanism, thin films technology, organic field-effect transistors, organic light-emitting diodes, organic solar cells, organic semiconductor sensors, molecular electronic logic architectures and Nanotechnology.

EE681 Selected Topics in Electrical Engineering (3-0-3)
This course relates with emerging trends and selected research based topics on any of the sub-streams in electrical engineering. This course aims to enrich students with fast evolving fields of electrical engineering and contents will be non-overlapping with the other course.

EE599 MS Thesis (6)
EE699 PhD Dissertations (18)

Research and Labs Facilities

Keeping in mind the needs of today and the future, the faculty of Electrical Engineering has an assortment of equipment and facilities for the students so they can cope up with the fast moving technology. It provides them with the opportunity to learn and understand the concepts of electronic and power engineering and constructively transform them to practical use. These laboratories provide support for research and development to faculty, graduate students and undergraduates in the following thrust areas

- Communication and Digital Signal Processing
- Microelectronics and ASIC Design
- Electric Power and Control System

Major laboratory facilities of the Faculty of Electrical Engineering are summarized below,

Wave Propagation and Antennas Lab
This lab contains microwave training systems, antennas, waveguides, and transmission line demonstrators suitable for the study of generation, propagation, and reception of microwave signals. This lab is used in connection with Wave Propagation & Antennas and Microwave Engineering courses.

Electric Machines Lab
In this laboratory, students augment their concepts about the fundamentals behind working of transformers and the rotating machinery. The laboratory is equipped with single and three-phase transformers, induction motors, synchronous generators and motors, DC generators and motors, DC and AC power supplies, electrical and mechanical loads, and a number of test and monitoring equipment such as watt-meters, power-factor meters, voltmeters, ammeters and frequency meters. The students also learn practically the synchronization of two electricity networks and the power flow between them.

Digital Logic Design Lab
This lab is meant for the understanding of fundamental digital logic related concepts and contains 30 sets of oscilloscopes, digital trainers, Digital Multi-Meters (DMMs), function generators and support accessories. Starting with simple Universal NAND/NOR Gates, the students learn to design and implement different combinatorial as well as sequential circuits taught in the associated theory class.

Analog Electronics Labs
There are two analog electronics laboratories in the faculty, where in total, there are above 60 sets of oscilloscopes, trainers, power supplies and functional generators. The labs are used for the courses of Electronics Devices and Circuits & Electronic Circuit Design, and Linear Circuit Analysis. The labs augment the theoretical knowledge, which the students acquire in classroom theory. On the basis of experiments in these labs, the students not only can verify their theoretical analysis but also learn about the limitations associated with the equipment, which are always there regardless of how sensitive and expensive the equipment is. The labs also help to enhance the knowledge of students in fundamental design concepts.

Communication Systems Lab
The faculty has a very comprehensive Communication Systems Laboratory, which covers both the analog and digital communication systems. The central equipment of the lab is set of training panels, which have built-in modules ranging from angle modulation to coding of digital data. The panels are equipped with 200 kHz function generators, noise generators and spectrum analyzer modules to help set up various experiments. In addition to this, the lab is also equipped with universal MCU-controller trainers and computers. There is also telephone switching module and optical fiber transmitter and receiver trainers.

Signal Processing Simulation Lab
This lab has 50 networked Pentium IV PCs with various kinds of software packages installed including Matlab, PSpice, Microwave Office, ModelSim, Xilinx. Matlab is used for running exercises in the courses of Signals and Systems, Control Systems, Digital Communication Systems, Digital Signal Processing and Digital Image Processing. PSpice, a simulation tool for analyzing electric and electronic circuits is used in the labs of Linear Circuit Analysis & Electrical Network Analysis, and Electronics Devices and Circuits. Matlab and PSpice can also be used to simulate the results of the tutorial and assignment problems in the course of Power Electronics.

Linear Control Systems Lab
This laboratory offers a unique opportunity to familiarize with PLC structure and learn their programming techniques. PLCs are attached with models to demonstrate different PLC functions and understand their applications. These models include: Traffic Light Model, Surface Treatment Chariot Model, and Pneumatically Controlled Robotic Arm. Controls lab is also equipped with models that demonstrate and give practical knowledge about different theoretical concepts studied in Control Systems course, such as PID control, state feedback control, positional control and speed control. These models include: Digital Inverted Pendulum, Digital Servo Workshop, Magnetic Levitation Unit, Twin Rotor MIMO system, and Analogue Computers.

Microprocessor Interfacing Lab

The intent of this laboratory is to provide an insight to a typical microprocessor and microprocessor-based systems. Used in Microprocessor System course, this laboratory is equipped with trainers designed to provide comprehensive hands-on training employing the latest state-of- the-art technology. Lab-Volt trainer and 8051 Microcontroller trainers used in this Lab employs a modularized approach to teach microprocessor architecture and interfacing concepts and its applications. In addition to these trainers, this laboratory is also equipped with a universal programmer used to program microcontrollers of different types as well as EPROMs.

ASIC Design Lab

This laboratory is equipped with VLSI and Electronic Design Automation (EDA) tools, such as Xilinx, ModelSim, Leonardo Spectrums, place and route tools, ISE web pack, Microwind and DCH tools. Altera and Quartus are available for AIC design in HDL (Hardware Description Language) working environment for simulation and synthesis. Moreover, the laboratory is equipped with number of Xilinx/Altera FPGA development boards.

Instrumentations and Measurements Lab

This Lab covers investigation of instruments, error types and characteristics of instruments, determination of dynamic behavior of typical sensors, signal conditioning circuits such as DC and AC bridges, instrumentation amplifiers and filters, computer-based data and signal processing for different measurement systems.

Power Simulation Lab

This lab has 50 networked Core i7 PCs with various kinds of Software packages installed including Matlab, PSpice, Power World Simulator and Calculus. Matlab is used for running exercises in the courses of Signals and Systems, Control Systems, Digital Communication Systems, Digital Signal Processing, Digital Image Processing, Power System Analysis and Design and Power distribution and utilization. PSpice, a simulation tool for analyzing electric and electronic circuits is used in the labs of Linear Circuit Analysis & Electrical Network Analysis, and Electronics Devices and Circuits. Power World Simulator is used for solving problems involving power flows. Calculus is used for luminance calculations in lighting systems.

Power Electronics Lab

Power Electronics Lab is equipped with the state-of-the-art instrumentation for design, simulation, layout, prototyping, and testing of switching/analog circuits. The experiments in the Power Electronics Laboratory involve modeling, control, topologies, and integration of switching converters, inverters, single-phase and three-phase Thyristor, power factor correction methods and active power filters, power conversion for alternative energy sources.

Power System Labs

The main focus of these labs is to introduce students with the state of the art power distribution and utilization approaches and equipment. To strengthen the newly-launched specialization of the Power Engineering, the following labs are being established:

- Power Transmission Lab
- Power Distribution and Utilization Lab
- Power Generation Lab
- Power System Protection Lab
- High Voltage Engineering Lab

Printed Electronics & Device Characterization Lab

This lab includes basic fabrication setups including Laser Ablation for LIG synthesis, pneumatic extrusion system for 3D printing of fluidic materials, UV surface treatment, and drop casting for printed electronic devices. It also includes the characterization systems for the fabricated devices including a controlled environment chamber for humidity, temperature, and gas sensors, and an in-house developed potentiostat for electrochemical measurements.

Organic Semiconductors Electronics Lab

This Lab specializes in the fabrication of electronic devices using organic materials, including semiconductors, conductors, and dielectrics. Our research focuses on developing a variety of sensors, solar cells, and field effect transistors, while also investigating their electric properties and characteristics.

Research Groups

1.TeleCoN Research Group

The Telecommunications and Networking (TeleCoN) is an inter-faculty Research Lab jointly established by the Faculty of Electrical Engineering and the Faculty of Computer Sciences & Engineering. The Executive Committee of SOPREST and GIK Institute in its 62nd meeting accorded approval to establish the TeleCoN Research Group/Lab. The TeleCoN Lab seeks to foster high-quality research focused on the design and analysis of communication systems and network architectures and protocols that are cost effective, scalable and meet the emerging needs for high-performance, high-capacity and reliable communications. The TeleCoN Research Group promotes fundamental and applied research employing cutting-edge networking, communication and signal processing techniques and technologies. General areas of interest of the TeleCoN Research Group include resource allocation, traffic management, teletraffic engineering, security, energy efficiency, cooperative communications and quality of service in Internet, wireless sensor networks, mobile ad-hoc and vehicular networks, cognitive radio networks, multi-user relay networks, and 5G heterogeneous cellular networks. Internationally, the members of this group have joint research with institutions like the University of Agder, Norway, University of Brighton, UK, and King Abdulaziz University, Saudi Arabia. Industrially, it engages with companies such as Fowrry Technologies, Islamabad. TeleCoN is a leading force in advancing telecommunications and networking research, pushing the boundaries of communication technologies.

Members

Dr. Zia ul Haq Abbass
Dr. Ghulam Abbas
Dr. Ahmad Kamal Hassan
Dr. Zaiwar Ali
Dr. Muhammad Irfan

2.Electrical Power System Research Group

The Electrical Power System Research Group is a dynamic and innovative team dedicated to advancing the knowledge of power generation, transmission, and distribution systems. The group is particularly interested in integrating renewable energy sources into these systems as well as exploring new insulation materials by investigating different types of reinforcing fillers. One of the main research areas is the smart grid technologies for power quality control and optimization, utilizing machine learning and reinforcement learning techniques. Additionally, the group also focuses on studying electric/magnetic stress control and aging of composite insulators using state-of-the-art simulations and electrical characterization and diagnostic techniques. With access to the advanced facilities like the High Voltage Engineering and Smart Grid Labs, the group is committed to develop sustainable solutions for the power industry. The members of this group have joint research with Aalto University, Finland and the University of Waikato, New Zealand. The group is also engaged with the local industry such as Pak Elektron Limited (PEL), K-Electric, and Micro-Merger Pvt. Limited.

Members

Dr. Hadeed Ahmed Sher
Dr. Taqi Ahmed Cheema
Engr. Muhammad Umar Afzaal

3.Power Electronic Applications in Renewable Energy Lab (PEARL)

Dedicated to a sustainable future, PEARL focuses on optimizing power electronic systems for renewable sources like solar and wind. Its mission centers on designing and controlling converters, inverters, and energy storage systems to enhance efficiency and reliability. PEARL conducts cutting-edge research in power conversion, grid integration, energy storage, and control algorithms. Beyond research, it shares knowledge through workshops and seminars, cultivating a skilled workforce. The members of this group have joint research with institutions worldwide such as King Saud University, Kingdom of Saudi Arabia and École de Technologie Supérieure, Montréal, Québec, Canada, and it aims to advance renewable energy and power electronics. The group is principal organizer of the prestigious International Conference on Emerging Power Technologies (ICEPT), and the first two issues of the conference are ICEPT 2021 and ICEPT 2023.

Members

Prof. Dr. Muhammad Akbar
Dr. Shahid Alam
Dr. Ammar Arshad
Dr. Attique Ur Rehman
Engr. Umar Afzaal

4.Control, Automation, and Robotics (CARs)

The Control, Automation and Robotics (CARs) Group has been an integral part of the department of Electrical Engineering. Our mission is to promote cutting-edge research and innovation in the field of Control Engineering. We specialized in dynamics system modeling and designing automated feedback control

systems. CARs group is committed to solving control engineering problems by integrating artificial intelligence in the dynamics of the autonomous system. The CARs group has diversified applications such as home automation, industrial control and automation, and Military control based on Guidance, Navigation and Control (GNC). GNC opens the research platform for Autonomous Vehicle. CARs value global engagements with institutions such as UNSW and UTS Australia and the group also engages with national institutes. The group includes seven eminent faculty members with diverse research interest,
exploring the following thrust areas:

- Nonlinear and Robust Control
- Robotics and Embedded Control
- Discrete Time Systems and Variable Structure Control
- Reinforcement Learning and Adaptive Control
- Optimal Control, Multi-agent systems, Switched and Hybrid Systems
- Model Order Reduction
- Artificial Intelligent Control System

Members
Prof. Dr. Nisar Ahmed
Dr. Adnan Noor
Dr. Dur-E-Zehra Baig
Dr. Memoon Sajid
Dr. Abid Imran
Mr. Mazhar Javed

5.Microwave, Antenna, and Photonics Research Group

The Microwave, Antenna, and Photonics Research Group conduct research across a broad range of topics, encompassing both fundamental and applied aspects. Applied research includes the design of selective structures, tunable metamaterials, metasurfaces, and planar circuits for mm-wave, microwave, and optical frequencies. Optical devices play a crucial role in sensing and communication technologies. The methods for analysis encompass novel discretization techniques, fast methods in the frequency and time domains, antenna gain enhancement techniques as well as multi-scale analysis. The members of this group have joint research with institutions worldwide such as Politecnico di Torino, Italy, University of Manchester, UK, and Penn State University, USA. National industrial engagements include National Radio Telecom Corporation, (NRTC). Additionally, the group places a primary focus on simulations using advanced software packages such as ADS, CST, HFSS, FDTD Lumerical, and COMSOL Multi-Physics. For analytical solution analysis, the group employs software tools such as MATLAB, MATHCAD, and MATHEMATICA.

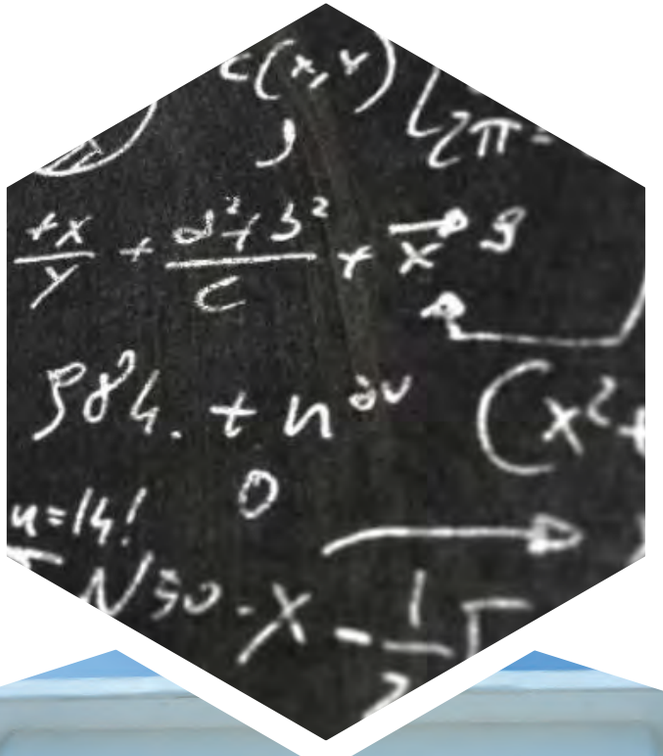
Members
Dr. Arbab Abdur Rahim
Dr. Adnan Noor
Dr. Husnul Maab
Dr. Waleed Tariq Sethi

6.Accelerated Reconfigurable Embedded Systems (ARES)

The ARES Research Group is at the forefront of next-generation digital technology development merging hardware and software. The group specializes in Field Programmable Gate Arrays (FPGAs), a versatile form of digital hardware, and leverages Machine Learning and Artificial Intelligence to develop advanced solutions for Embedded Systems. They pioneer in memory design research and edge computing, a method that decentralizes data processing to optimize real-time applications. Integrating nanotechnology, the ARES group explores into the world of miniaturization to create efficient, powerful chip designs. By combining cutting-edge technology and innovative thinking, the ARES group propels the boundaries of digital capabilities, driving forward a new era of intelligent, efficient digital systems that are set to redefine our technological landscape. The members of this group have joint research with institutions worldwide such as King Abdulaziz University, Saudi Arabia and Ulster University, United Kingdom. The group is engaging with local industry namely ATS Islamabad, Innovation Lab, Faisalabad, and Pack Movers, Lahore.

Members
Dr. Muhammad Irfan
Dr. Memoon Sajid
Dr. Zaiwar Ali
Dr. Fahad bin Muslim
Dr. Waqar Ahmad
Engr. Abubakar

FACULTY OF ENGINEERING SCIENCES



Dean
Engr. Dr. Naveed Razzaq Butt,
PhD (LU, Sweden)

Faculty

Sirajul Haq, PhD (University of Liverpool, UK)
Muhammad Zahir Iqbal, PhD (Universitat Politècnica de Catalunya, Spain)
Muhammad Usman, PhD (Hanyang University, South Korea)
Muhammad Omer Bin Saeed, PhD (King Fahd University of Petroleum & Minerals, KSA)
Tahseen Amin Khan Qasuria, PhD (GIK Institute, Pakistan)
Asad Mahmood, PhD (Telecom Paristech, Paris, France)
Fahd Sikandar Khan, PhD (University of Tokyo, Tokyo, Japan)
Usman Habib, PhD (University of Kent, United Kingdom)
Minhaj Zaheer, PhD (University of Technology, Finland)
Nasir Javed, (Rutgers University, USA)
Tahir Naseem, PhD (Koç University, Turkey)
Zahid Ahmad, PhD (Quaid-e-Azam University, Pakistan)
Babar Zaman, PhD (Universiti Teknolofi Malatsia)
Shahid Ahmad, MS (University of Illinois, Urbana Champaign, USA)
Fahad Zulfiqar, MS (University of Sheffield, England)
Muhammad Saqib, MS (NUST, Islamabad, Pakistan)
Asif Ahmad, MS (University of Engineering and Technology, Peshawar)
Muhammad Muti Ur Rehman, MS (Quaid-e-Azam University, Pakistan)
Ayesha Noreen, MS (GIK Institute, Pakistan)

Faculty (on study leave for PhD)

Rahim Umer (Nanjing University of Aeronautics and Astronautics, China)
Taimoor Ali (University of Oxford, UK)

Joint Faculty

Khasan Karimov, PhD (Physical Technical Institute S.-Petersburg, Russia)
Mohammad Akbar, PhD (Tokyo University, Japan)

FACULTY OF ENGINEERING SCIENCES

The Engineering Sciences program is designed to prepare graduates with profound interdisciplinary knowledge for emerging technologies, which are not adequately covered by traditional engineering programs. In this context, the extensive growth of industrial mathematics, photonic & optoelectronic industries, lasers, semiconductor materials & devices, superconductors and digital systems have been particularly kept in mind. Emphasis is also laid on understanding the microscopic theories working behind these applied disciplines. As such the program also encompasses a strong theoretical component both in applied physics and mathematics. The program is flexible enough to incorporate other modern disciplines and new developments, as they may occur in future.

The Faculty of Engineering Sciences offers graduate courses and facilitates research leading to MS and Ph.D. degrees in the emerging fields of engineering science and technology in order to produce effective practicing engineers. The program is focused to cope with the urging demands of the new millennium industrial needs of the country. Alongside the excellence in teaching, the Faculty of Engineering Sciences aims to become a center of excellence in research and development in the following fields of engineering sciences and technology.

- **Group A**: Applied Mathematics
- **Group B**: Applied Physics
- **Group C**: Engineering Specializations:
- (1) Photonics (2) Digital Systems (3) Signal Processing

In undertaking such a venture, the faculty depends on its existing facilities and future support from the Institute. Present facilities that make the program feasible include, The availability of faculty members experienced in teaching and research.
Well established research laboratories to meet the requirements of graduates.
Multidisciplinary nature of the engineering sciences program.

COURSE WORK:

MS degree

The courses offered by the FES are categorized as core courses and elective courses. A student, specializing in any area, will be required to take minimum of two core courses from his/her specialization stream and remaining from elective courses. The electives may be selected with the consultation of the advisor.

PhD degree

The course work to be taken by a student will be decided by a PhD Guidance Committee. Out of the six courses, four must be related to his/her area of specialization.

LIST OF COURSES

CORE COURSES

Core Courses for the subgroups will be as follows

- **Group A – Applied Mathematics**
- ES521 - Advanced Transform Techniques
- ES526 - Analytical Solution of Partial Differential Equations
- ES531 - Computational Methods for Engineers
- ES544 - Random Processes
- **Group B – Applied Physics**
- ES581 - Advanced Experimental Techniques
- ES531 - Computational Methods for Engineers
- ES511 - Solid State Physics
- ES566 - Atomic and Molecular Spectroscopy
- **Group C-1 - Specialization: Photonics**
- ES512 - Fundamentals of Photonics
- ES535 - Quantum Engineering of Optoelectronic Devices
- ES5531 - Computational Methods for Engineers
- ES511 - Solid State Physics
- **Group C-2 - Specialization: Digital Systems**
- ES536- Fundamentals of Digital Systems
- ES539 - VLSI Design
- ES531 - Computational Methods for Engineers
- ES553 - Digital Signal Processing
- **Group C-3 - Specialization: Signal Processing**
- ES544 - Random Processes
- ES531 - Computational Methods for Engineers
- ES553 - Digital Signal Processing
- ES5XX - Optimization Techniques

Group A

ES 522	Advanced Fluid Mechanics
ES 523	Special Relativity
ES 524	General Relativity
ES 527	Asymptotic Methods for Differential Equations
ES 532	Applied Combinatorics
ES 533	Numerical Methods for Partial Differential Equations
ES 534	Numerical Functional Analysis
ES 537	Applied Graph Theory
ES 541	Variational Methods in Mechanics
ES 542	Finite Element Methods for Engineers
ES 543	Perturbation Methods
ES 621	Advanced General Relativity
ES 631	Numerical Methods in Ordinary Differential Equations
ES 691	Special Topics in Applied Mathematics

Group B

ES 514	Thin Films
ES 515	Two-Dimensional Materials and Devices
ES 516	Spintronic Devices
ES 517	Quantum Devices
ES 518	Mesoscopic Physics
ES 519	Energy Storage Systems
ES 561	Fourier Optics
ES 562	Organic Solar Cells: Materials and Device Physics
ES 564	Astrophysics
ES 576	Organic Optoelectronics
ES 577	Integrated Optics
ES 611	Advanced Nuclear Astrophysics
ES 612	Computational Nuclear Physics
ES 642	Organic Electroluminescence
ES 692	Special Topics in Applied Physics

Group C

ES 513	Semiconductors
ES 525	Principles of Remote Sensing

ES 528	Estimation and Detection Theory
ES 537	Reconfigurable Computing and FPGA Architecture
ES 538	Design for Test and Testability
ES 552	Biophotonics
ES 554	Digital Control System
ES 555	Adaptive Filtering
ES 556	Advanced Computer Architecture
ES 557	Digital Image Processing
ES 558	Advanced Digital Signal Processing
ES 559	Digital Communication
ES 563	Laser Materials Processing
ES 565	Photonics and Optical Communication
ES 567	Photonic Devices
ES 572	Principles of Laser Engineering
ES 573	Optical Fibers and Applications
ES 574	Applications of Lasers
ES 579	Advanced Digital System Design
ES 585	Photonics Networks
ES 693	Special Topics in Digital Systems Engineering
ES 694	Special Topics in Photonics Engineering

COURSE DESCRIPTION

ES-511 Solid State Physics (3-0-3)
Review of atomic structure: Rutherford model of atom and drawbacks, Bohr model of atom and drawbacks, Sommerfeld's relativistic atom model and draw backs, quantum theory of atoms, electronic configuration of atoms, periodic table and wave mechanical concept of atom.
Interatomic forces and bonding in solids: Potential energy function between atoms, cohesive energy, bonding types (interatomic and intermolecular) and properties, Madelung Constant and repulsive exponent, Born-Haber cycle, general physical properties of solids due to bonding.
Physics of crystals: Lattice points, space lattice, basic crystal structure, unit cell, lattice parameters, crystal systems, crystal operations, symmetry, space groups, Bravais space lattices, metallic crystal structures, Miller indices, crystal planes, allotropy and polymorphism, imperfections in crystals, reciprocal lattices.
Wave-particle dualism: de-Broglie hypothesis, experimental study of matter waves, the Davisson-Germer experiment, Heisenberg uncertainty principle, x-ray diffraction, Bragg's law, Bragg's x-ray spectrometer, correction for Bragg's equation.
Electrical and thermal properties of metals: Classical free electron theory of metals and drawbacks, quantum theory of free electrons, classical and Schröndinger wave equation, importance and physical significance of Schröndinger equation, Fermi-Dirac statistics and electronic distribution in solids, density of states and Fermi energy, heat capacity of electron gas, mean energy of electron gas, electrical conductivity explained using quantum theory, electron-scattering mechanism and variation of resistivity with temperature, resistivity of alloys, thermal conductivity in metals, thermal expansion, band theory of solids, metals, insulators and intrinsic semiconductors.

ES-512 Fundamental of Photonics (3-0-3)
Nature and properties of light, light sources and laser safety, basic geometrical optics, basic physical optics, lasers, optical detectors and human vision, optical waveguides and fibers, fiber optic telecommunication, photonic devices for imaging, display, and storage, basic principles and applications of holography.

ES-513 Semiconductors (3-0-3)
Semiconducting materials, mobility and electrical conductivity, energy bands, thermal properties, carrier modeling, carrier action, PN junctions and diodes, bipolar transistors, field effect transistors, power devices, integrated circuits and devices, assessment of materials for PV solar cells applications.

ES-514 Thin Films (3-0-3)
Deposition techniques, properties, characterization, structure, transport - phenomena & super-conductivity in thin films, applications.

ES-515: Physics of 2D Materials (3-0-3)
Introduction of two-dimensional (2D) layered materials i.e. graphene, hexagonal boron nitrite and various transition metal dichalcogenides, device fabrication techniques for 2D materials and their Van der Waals heterostructures, structural characterization and electrical transport of 2D field effect transistors (FETs), carrier density and mobility calculations, opto-electronic, gas, chemical and humidity sensing applications of 2D materials FETs, 2D layered heterostructures for memory devices.

ES-516: Spintronic Devices (3-0-3)
Introduction of spin electronics, principle of spintronic devices, selection of materials for spin devices including ferromagents and interface materials, current-in-plane (CIP) and current perpendicular-to-plane (CPP) spin valve devices, magnetic tunnel junctions, types of magnetoresistance (MR):anisotropic magneto resistance (AMR), giant magnetoresistance (GMR), colossal magnetoresistance (CMR) and tunneling magnetoresistance (TMR), applications of two-dimensional (2D) materials i.e. graphene, hexagonal boron nitrite, various transition metal dichalcogenides and organic materials for spintronic devices, spin valve device fabrication techniques for 2D materials and their van der Waals heterostructures, structural characterization and magnetotransport of spin valve devices, temperature dependence of junction resistance and magnetotransport in spin valve devices, spin injection, spin tunneling process, spin accumulation, spin diffusion length, two, three and four terminal lateral spintronic devices, spin field effect transistor, hybrid electronics, spin transport in semiconductors, spintronics for next generation innovative devices.

ES-617 -Spin and Quantum Electronics (3-0-3)
Introduction and principles of spin electronics, fabrication of spin valve devices, magnetic tunnel junction, electron tunneling processes, magneto-resistances, structural characterization of devices, spin related phenomena and processes, spintronics for next generation innovative devices. Introduction and principles of quantum electronics, weak localization and quantum Hall effect, electron scattering mechanism in Hall system, QHE in layered and Van der Waals heterostructures and 2DEG systems, magnetotransport and remote sensing of microwave reflection in 2DEG systems under microwave excitation.

ES-521 Advanced Transform Techniques (3-0-3)
Integral transforms, Fourier, Laplace, Hankel and Melin transformations and their applications, singular integral equations, Weiner-Hopf techniques, applications of conformal mapping, introduction to asymptotic expansions.

ES-522 Advanced Fluid Mechanics (3-0-3)
Principal concepts and methods of fluid dynamics, Energy equations for continua, Navier-Stokes equation for viscous flows, Lubrication Theory, Circulation and vorticity theorems, Introduction to turbulence; Surface tension and surface tension driven flows, Circulation, vorticity, rotating and non-rotating flow of an ideal fluid, Bernoulli's theorem, Resistance and buoyancy of an ideal fluid, Inviscid Flow, Governing equations of fluid motion with emphasis on inviscid flow, Principles of irrotational flow, Mathematical techniques including conformal representation.

ES-523 Special Relativity (3-0-3)
The postulates of special relativity, the paradox of special relativity, the light cone, simultaneity in special relativity, time dilation and length contraction, Lorentz and Galilean transformations, Minkowski's four-dimensional spacetime, Maxwell's equations in special relativity, the space-time continuum of special relativity.

ES-524 General Relativity (3-0-3)
Manifolds, tensors, derivative operators and curvature, homogeneous, isotropi, cosmology, exact solutions of schwarzchild, minkowski, desitter, anti-desitter, kerr, robertson- walker and riessner-nordstrom space times.

ES-526 Analytical Solution of Partial Differential Equations (3-0-3)
A brief review of differential equations: power series including Frobenius method, canonical forms for hyperbolic, parabolic and elliptic equations, analytical solutions of hyperbolic, parabolic and elliptic equations with and without boundary conditions, separation of variable methods, neumann problem, exterior and interior Dirichlet problem, Green's function, the eigenfunction method.

ES-527 Asymptotic Methods for Differential Equations (3-0-3)
Green's functions, asymptotic approximations, regular and singular perturbations, Neumann boundary value problem for a domain with “thin” void, asymptotic

model of a solid containing small cavity, asymptotic model for a domain containing a small inclusion. dirichlet problem, the dipole matrix, boundary value problems in thin domains, eigenvalues and eigenfunctions of a perturbation problem, A boundary perturbation problem.

ES-531 Computational Methods for Engineers (3-0-3)
Direct and indirect methods for linear equations, eigen value problems and eigen vectors, finite difference methods for boundary value problems and partial differential equations,

ES-533 Numerical Methods for Partial Differential Equations (3-0-3)
Parabolic equations, explicit and implicit methods, consistency, stability and convergence, hyperbolic equations, method of characteristic and lines, finite difference methods, elliptic equations, finite difference replacements, finite element methods for elliptic problems.

ES-534 Numerical Functional Analysis (3-0-3)
Sets, metric space, limit, completeness, convergence, contraction mapping, linear space, norm, vector, matrix norm, normed space, branch space, inner product, Hilbert space, operations.

ES-537 Reconfigurable Computing and FPGA Architecture (3-0-3)
Use of FPGAs and the design of the FPGA architecture, comparison of efficiency and programming effort of FPGA based signal processing with a DSP processor implementation, architecture of FPGAs, modeling the area and delay of key circuitry, programmable routing, computer aided design (CAD) tools for FPGA architecture.

ES-538 Design for Test and Testability (3-0-3)
Logic simulation, fault modeling, fault simulation, algorithms and techniques for

automatic test pattern generation in combinational and sequential circuits (D-algorithm, PODEM, recursive learning), design error/fault diagnosis, introduction to functional testing of microprocessors, ALUs and memories, design for testability, and logic and scan built-in self-test.

ES-541 Variational Methods in Mechanics (3-0-3)
The Euler-Lagrange equation, Ritz's method, boundary conditions, continuity conditions, Galerkin's method, minimizing sequence, transformation in variational problems, elasticity, Castgliano's theorem, and eigen values, the finite element method, general use of Lagrange multiplier.

ES-542 Finite Element Methods for Engineers (3-0-3)
Sobolev space setting, variational form, Ritz and Galerkin's method, basic coding techniques, application to engineering problems.

ES-543 Perturbation Methods (3-0-3)
Asymtotic sequences and series, asymtotic expansion of integral, solution of differential equations about regular and irregular singular points, nonlinear differential equations, perturbation methods, regular and singular perturbations, matched asymtotic expansions and boundary layer theory, multiple scales, WKB theory.

ES-544 Random Processes (3-0-3)
Random function, autocorrelation and cross-correlation functions, stationary random processes, stochastic calculus Poisson, Gaussian, Markov processes with independent increments, spectral density, white noise, cross- spectral density, linear systems, estimate of the response of linear systems.

ES-551 Fundamentals of Digital Systems (3-0-3)
Design and analysis of digital systems for control, communication, signal and data processing, their interface with real world, analog to digital conversion, z-transformation, digital design using verilog HDL.

ES-552 Introduction to Biophotonics (3-0-3)
Introduction, fundamentals of light and matter, basics of biology, fundamentals of light-matter interactions, principles of lasers, current laser technology and nonlinear optics, photobiology, bioimaging, principles, techniques and applications, optical biosensors, microarray technology for genomics and proteomics, flow cytometry, light-activated therapy: photodynamic therapy, tissue engineering with light, laser tweezers and laser scissors, nanotechnology for biophotonics, bionanophotonics, biomaterials for photonics.

ES-553 Digital Signal Processing (3-0-3)

Analysis and representation of discrete-time signal systems, discrete-time convolution, difference equations, the z-transform, and the discrete-time Fourier transform, digital systems, FIR and IIR digital filters, some aspects of Kalman filtering, adaptive filtering and stochastic process.

ES-554 Digital Control System (3-0-3)
Fundamental concepts, principles and application of digital control system analysis and design, classical control design methods and the modern control design techniques, digital control system characteristics, stability analyses, control system frequency response, digital control system design using transform techniques, using state space methods, pole placement design, state estimation and estimator design, and linear quadratic optimal control.

ES-555 Adaptive Filtering (3-0-3)
Basic theory of adaptive filter design and implementation, steepest descent, LMS algorithm, mixed norm algorithms, RLS algorithm, nonlinear adaptive filters, and blind de-convolution, analysis of performance and applications.

ES-556 Advance Computer Architecture (3-0-3)
Introduction to computer architectures, models of scalability and performance models, review of computer organization, overview of instruction set design, instruction-level parallel processors (ILP) , pipelined processors, pipeline scheduling, vector processing, introduction to superscalar and VLIW/EPIC processors, dynamic scheduling, branch prediction, memory design, I/O system optimizing compilers, code scheduling for ILP processors, multiprocessing and introduction to reconfigurable architecture.

ES-561 Fourier Optics (3-0-3)
Plane waves and spatial frequency, Fresnel and Fraunhoffer diffraction, Fourier transforms and diffraction patterns, Fourier transforms in cylindrical coordinates, special functions in photonics and their Fourier transforms, Fourier transform properties of lenses, frequency analysis of optical systems, spatial filtering, holography.

ES-562 Organic Solar Cells: Material and Device Physics (3-0-3)
Introduction to organic solar cells, active layer materials for organic solar cells, bulk-heterojucntion solar cells, dye-sensitized solar cells, plasmonic effects in organic solar cells, hybrid organic-inorganic solar cell, exciton and charge dynamics studies in organic solar, fabrication and characterization techniques of organic solar cells.

ES-563 Laser Materials Processing (3-0-3)
Background on laser processing, laser cutting, drilling, welding, marking, laser surface modification, laser forming, medical and nanotechnology, applications of lasers

ES-564 Astrophysics (3-0-3)
Radiation transfer and internal structure of normal stars, red giants, white dwarfs, neutron stars, pulsars, nova and super-nova explosions, nuclear theories of stellar evolution, binary systems and galactic x-ray sources, galaxies, quasars and cosmology.

ES-565 Photonics and Optical Communication (3-0-3)
Introduction to photonics and optical communication, review of optics, optical waveguides, optical fibers, optical sources and transmitters, optical detectors and receivers, optical communication systems, optical devices, optical MUX and DEMUX, systems design, optical measurements

ES-566 Atomic and Molecular Spectroscopy (3-0-3)
Introduction, microwave spectroscopy, instrumentation and applications, infra-red spectroscopy, instrumentation and applications, Raman spectroscopy, instrumentation and applications, electronic spectroscopy, instrumentation and applications, spin resonance spectroscopy, instrumentation and applications, laser spectroscopy, types, instrumentation and applications.

ES-567 Photonics Devices (3-0-3)
Light emitting diodes: Principles, homojunction LEDs, heterostructure high intensity LEDs, output spectrum, quantum well high intensity LEDs, LED materials and structures, LED efficiencies and luminous flux, basic LED characteristics, LEDs for optical fiber communications, phosphors and white LEDs, LED electronics. Laser diodes: Principle of the laser diode, heterostructure laser diodes, quantum well devices, elementary laser diode characteristics, steady state semiconductor rate equations, single frequency semiconductor lasers, vertical cavity surface emitting lasers. Optical amplifiers: Erbium-doped fiber amplifiers, Raman amplifiers, semiconductor amplifiers. Photodectors: The pn junction photodiode, Shockley–Ramo Theorem and external photocurrent, absorption coefficient and photodetector materials, quantum efficiency and responsivity, The pin photodiode, avalanche photodiode, heterojunction photodiodes, Schottky junction photodetector, phototransistors, photoconductive detectors and photoconductive gain, basic photodiode circuits. Solar Cells: Basic Principles, Parameters, equivalent circuit of a solar cell, solar cell structures and efficiencies. Optical modulators-Electro-optic, acousto-optic, magneto-optic: Principles and applications. Liquid crystal displays: Liquid crystal types, materials, LCD cell, characteristics, applications. Integrated optic devices: IO phase shifter, IO switch, IO splitter, IO modulator.

ES-569 Advanced Quantum Mechanics (3-0-3)
Overview of basic concepts of quantum mechanics, time-dependent perturbation theory, systems of identical particles and applications, spin and magnetic moment, addition to angular momenta, many-electron atoms, the Hartree-Focks method, scattering theory: amplitude of scattering, cross-section, phase shifts, Born approximation, quantum theory of radiation, second quantization and many-body theory.

ES-572 Principles of Laser Engineering (3-0-3)
Laser generation, optical resonators, laser pumping, rate equations, broadening mechanisms, beam modification, beam characteristics, types of lasers, beam delivery, laser applications, laser safety.

ES-573 Optical Fibers and Applications (3-0-3)
Introduction, optical fiber wave guides, signal degradation in optical fibers, optical fibers, fiber fabrication and cabling, optical sources, detectors, and receivers, coupling, transmission link analysis, optical fiber measurements, applications of optical fibers.

ES-574 Applications of Lasers (3-0-3)
Metrological applications: Alignment, gauging, surface inspection, optical radar. Scientific applications of lasers: Isotope separation, nuclear fusion, laser ablated plasma, laser-induced break-down spectroscopy.

Material Processing: Material processing with lasers, Interaction mechanism, material processing mechanism, drilling, cutting and welding, hardening. Medical applications: Medical lasers, Laser diagnostic, Laser in ophthalmology, laser in glaucoma, laser for general surgery, laser in dermatology, laser in dentistry. Military applications: Laser rangefinders, laser target designators, laser bathymetry, laser-guided munitions, infrared-guided missiles. Holography: Basic principle of holography, construction and reconstruction of Image on hologram and applications of holography. Optical Information Transmission and Storage: Laser beam communications, laser printing, optical disk systems.

ES-575 Laser Technology (3-0-3)
Semiconductor diode lasers: heterojunction structures, single-mode, broad-stripe, high power arrays, VCSELs, distributed Bragg reflectors, external grating-tuned cavities. diode-pumped solid-state lasers, microchip lasers, tunable solid-state media, ultrafast lasers, fibre amplifiers, fibre lasers, high power industrial lasers.

ES-576 Organic Optoelectronics (3-0-3)
Electronic processes in organic solids, organic photonic devices, organic photosensors, organic light-emitting diodes, organic lasers, organic optical amplifiers, organic solar cells based on small molecules, polymer solar cells, dye-sensitized solar cells (DSSCs).

ES-577 Integrated Optics (3-0-3)
Review of electromagnetic principles, dielectric slab waveguides, cylindrical dielectric waveguides, dispersion, shifting and flattening, mode coupling and loss mechanism, selected nonlinear waveguiding effects, integrated optical devices.

ES-579 Advanced Digital System Design (3-0-3)
Hardware descriptive languages, design both behavioral and register transfer level architectures and control units, different computer architectures, memories, digital interfacing, timing and synchronization, and microprocessor systems and embedded processors.

ES-581 Advanced Experimental Techniques (3-0-3)
Introduction to the synthesis methods, fabrication processes including lithography techniques, deposition techniques, vacuum technology, cryogenics, electrical and magnetic characterization techniques, impedance spectroscopy, optoelectronics, potentiostat, Raman spectroscopy, X-Ray diffraction, scanning probe microscopy, scanning electron microscopy.

ES-585: Photonics Networks (3-0-3)
Introduction to photonics networks, propagation of signals in optical fibers, components, modulation and demodulation, transmission system engineering, client layers of the optical layer, WDM network elements, control and management, network survivability, WDM network design, access networks, photonic packet switching, deployment considerations.

ES535 – Quantum Engineering of Optoelectronic Devices (3-0-3)
Carrier transport physics: Physics of carrier transport, transport parameters and coefficients, effect of transport parameters, carrier Transport Model
Optical properties of Materials: Optical Constants, Dielectric Function and Band Structure, Influence of electric fields on the dielectric function.
Material alloys and their heterojunctions: III-Nitrides, II-VI Compounds, Quaternary compounds
Quantum wells and Superlattices: Optimal Number of Quantum Wells, Lattice-matched Layers, Device Engineering:
Device Structure, Device Analysis, Spontaneous Emission, Auger Recombination, Internal Field Effects, Ray Tracing, Emission Spectra, Internal Quantum Efficiency and Carrier Leakage.

ES537 - Applied Graph Theory (3-0-3)
Fundamental Concepts: Paths, Cycles, Incidence and Adjacency Matrices, Vertex degree, Isomorphic and labeled graphs, Set Systems and Hypergraphs, Incidence Graphs, Union and Intersection of graphs.
Subgraphs: Edge and Vertex Deletion, Maximality and Minimality, Acyclic Graphs, Spanning Subgraphs, Induced Subgraphs, Weighted Graphs and Subgraphs, Vertex Splitting and Edge Subdivision, Decompositions and Coverings, Edge Cuts and Bonds
Connected Graphs: Walks, trail, Connection, Cut Edges, Euler Tours, Connection, Applications in Chemistry.
Trees: Forests and Trees, Spanning Trees, Cotrees, Applications in Computer Science
Non-separable Graphs: Cut Vertices, Non-separable Graphs, Blocks
Connectivity: Vertex Connectivity, Edge Connectivity, Biological networks
Engineering Applications of graphs: Introduction to electrical network theory
Planar Graphs: The Jordan Curve Theorem, Subdivisions, Faces, Euler's Formula, Bridges of Cycles. Applications in Chemistry
Vertex Colorings: Chromatic Number, Brooks' Theorem, Girth and Chromatic Number, Applications in Social Sciences

Matchings: Maximum Matchings, Augmenting Paths, Berge's Theorem, Matchings in Bipartite Graphs, Hall's Theorem, Matchings and Coverings, Matchings in Arbitrary Graphs, Applications in Finance & Management

ES532 - Applied Combinatorics (3-0-3)
Basic Counting Principles: The Addition Principle, The Multiplication Principle, Applications
Arrangements and Selections: Permutations, Combinations, Repetitions, Examples
Distributions: Basic Models for Distributions, Distributing a Combination of Identical and Distinct Objects, Equivalent Forms for Selection with Repetition
Binomial Identities: Standard Binomial Identities, Proving Equivalence, Advanced Binomial Identities, Applications
Generating Functions: Generating Functions as Models, Calculation of Coefficients, Exponential Generating Functions, Summation Methods for Generating Functions
Partitions: Partitions and their Relation to Generating Functions, Ferrers diagrams
Recurrence Relations: Recurrence Relation Models, Linear Recurrence Relations and their Solutions, Inhomogeneous Recurrence Relations and their Solutions,
Divide-and-Conquer Relations: Illustration of Divide-and-Conquer Recurrences by Real-World Problems
Inclusion-Exclusion: Counting with Venn Diagrams, Inclusion–Exclusion Formula, Restricted Partitions, Rook Polynomials, Applications of the Inclusion-Exclusion Principle.

ES518 - Mesoscopic Physics (3-0-3)
Introduction to electronic transport phenomena that occur in mesoscopic systems. The operation of single electron transistors, and calculate the electrical characteristics for specific geometries. The role of mesoscopic length and time scales, to distinguish diffusive from ballistic systems, and systems in which the electron transport has to described by classical or quantum mechanics, and describe the role of quantum interference. The electron transport in the quantum Hall regime, including edge channel flow, and calculate the corresponding electron transport and resistance. The phenomenon of conductance quantization in one-dimensional systems, and derive the expression for the energy dependent transport, including the role of scattering and finite temperature. The elementary electronic properties of graphene and graphene related 2D materials and describe the difference between them and conventional semiconductor materials. The manifestation of mesoscopic & macroscopic quantum phenomena, and make elementary calculations for these devices. The operation of spintronic devices and related effects.

ES519- Energy Storage Systems (3-0-3)
Fundamentals of supercapacitors and batteries, types and combinations of supercapacitors with batteries, charge storage mechanism, electrochemical characterization (CV, GCD, EIS etc), electrochemical behavior of nanostructured materials, behavior of dielectrics in capacitors and theories of dielectric polarization, The electrolyte factor in design and performance, evaluation of energy density and power density of supercapacitors, supercapattery and batteries. Capacitive-diffusive contribution in supercapattery, b-value of the supercapattery. Hydrogen energy storage.

ES5XX - Optimization Techniques (3-0-3)
Introduction to mathematical optimization, Linear programming and simplex method, special forms of simplex algorithm, basics of nonlinear optimization, maxima, minima, and saddle points, algorithms for unconstrained nonlinear programming problems, methods for constrained nonlinear programming problems, Lagrange multipliers and Lagrange function, Kuhn-Tucker conditions, various nonlinear programming algorithms, Error analysis of optimization methods.

ES525 - Principles of Remote Sensing (3-0-3)
History and introduction to remote sensing, Electromagnetic radiation and its interaction with atmosphere, Fundamentals of aerial photography, Digital image representation and formats, Land observation satellite platforms, Microwave remote sensing platforms, Thermal remote sensing platforms, Lidar (Light Detection and Ranging) , Parameters for digital image resolution, Data Preprocessing techniques, Image classification techniques, Metrics for Accuracy, Hyperspectral Data Analysis.

ES539 - VLSI Design (3-0-3)
Digital Systems and VLSI, Fabrication and Devices, Logic Gates, Combinational Logic Networks, Sequential Machines, Subsystem Design, Floor-planning, Architecture Design.

ES528 - Estimation and Detection Theory
Minimum variance unbiased estimation, Cramer-Rao lower bound, Linear models, General minimum variance unbiased estimation, Best linear unbiased estimators, Maximum likelihood estimators, Bayesian

estimators, Basics of statistical decision theory, Detection of known signals in noise, Detection of random signals, Examples and Applications.

ES-611 Advanced Nuclear Astrophysics (3-0-3)
Nuclear masses and stability, abundances of nuclei, weak interactions in nuclei, nuclear reaction networks, cosmological nucleosynthesis, stellar evolution, massive stars and their burning phases, gravitational collapse, supernovae and its associated dynamics.

ES-612 Computational Nuclear Physics (3-0-3)
Basics of Fortran language, numerical techniques in low energy nuclear physics, Gamow-Teller strength distribution in nuclei, nuclear shell model and random phase approximation theories, numerical calculations of strength distribution functions, nuclear weak decays in stellar matter, effects of changing model parameters in computational codes on the calculations of distribution function and associated weak decay rates in stellar matter.

ES-621 Advanced General Relativity (3-0-3)
Stationary, axisymmetric solutions, spatially homogeneous cosmologies, algebraically special solutions, perturbations, singularity, time like and null geodesic congruences, conjugate points, existence of maximum length curves, singularity theorems, black holes and the cosmic censor conjecture, general properties of black holes, the charged Kerr black hole.

ES-631 Numerical Methods in Ordinary Differential Equations (3-0-3)
Algorithms, Runge- Kutta, extrapolation and multi-step methods for stiff problems, analysis: conditioning of initial values problems, consistency, stability, and convergence of numerical methods, asymptotic behavior of error, singular perturbations and stiff problems, implementation strategies, software libraries.

ES-642 Organic Electroluminescence (3-0-3)
Electroluminescence in small molecules Emission Mechanism in organic light emitting diodes, physical properties of organic light emitting diodes in space charge-limited conduction regime, amorphous molecular materials for carrier injection and transport, chemistry of electrominescent conjugated polymers, organic electrophosporescence, past, present and future directions of organic electroluminescent displays, organic electroluminescent devices, photoexcited organic lasers.

ES691/692/693: Selected Topics in Applied Mathematics/Physics/Photonics/Digital Systems Engineering (3-0-3)
The Engineering Sciences program offers “Selected Topics,” only occasionally on topics of current interest. The selection of a topic is different every semester. Selected Topics courses do not repeat material presented by regular semester courses.
The committee will give two weeks to all units to edit their course descriptions and based on above structure and style.

ES-599 MS Thesis (6)

ES-699 PhD Dissertation (18)

Labs & Research Facilities

The Faculty of Engineering Sciences has a large number of teaching and research laboratories. These laboratories provide support for research and development to faculty and students in their perspective areas of interest:

The teaching laboratories include:
- Mechanics Laboratory
- Electricity and Magnetism Laboratory
- Circuit Analysis Laboratory
- Logic Design Laboratory
- Microprocessor/Microcontroller Interfacing

Research Laboratory
- Simulation Laboratory - Signals (UG)
- Semiconductor Laboratory
- Lasers and Optics Laboratory.

The names and a brief description of the research laboratories are given below:

Spectroscopy Laboratory
Contains PerkinElemer, Fourier transform infrared spectrometer (FTIR System 2000) and UV/VIS/NIR (Spectrometer Lamda-19). Facilities are available for the spectroscopic analysis of liquid, solid and gaseous samples in transmission as well as reflection mode. The lab also contains an ellipsometer (Ogawa Seiki) which can be used to find different parameters of thin solid films. The equipment has direct applications in environmental studies, chemical, biochemical and pharmaceutical industries.

Magnetism & Magnetic Materials Laboratory
The laboratory has a vibrating sample magnetometer (VSM) consisting of a high field electromagnet, a low temperature cryostat, a He closed cycle system. In this laboratory magnetic properties of different materials can be studied, e.g. high temperature superconductors, permanent magnets, soft magnetic materials, ferrofluids, and magnetic tapes (audio and video). By using high field electromagnet and four-probe method magnetoresistance and Hall effect measurements on semiconductors and superconductors can also be performed.

Simulation Laboratory
This lab has 20-networked Core i-7 – 4.6 GHz PCs running Windows 8.1. The software available in this lab includes Matlab and SIMUL8. Matlab allows engineers to perform complex simulation testing. Dynamic system and mathematical models built using MATLAB/Simulink can be executed in real-time without the need for time-consuming programming. SIMUL8 lets engineers animate business processes. It is more than an animation as it works the same way as an operation, ideas can be tried out and changes can be implemented in a JIT 'just in time' environment. The Simulation language used in the lab is VC.

Computational Physics Laboratory
This lab is recently established and is currently equipped with two Sun Ultra 40 2xAMD opteron model 254 (2.8 GHZ/Dual-core) processor workstations. The workstations are networked with Pentium 4 – 2-2 GHZ PCs running solaris environment. The machines compile the codes and run them efficiently. The lab provides state-of the art computing facilities to students and faculty.

Organic Electronics Research Laboratory
The laboratory has so far produced 08 PhDs and several MS students in numerous multidisciplinary areas of laser ablation, solar & thermal energy harvesting, optoelectronics, photonics, organic semiconductors, nanomaterials, etc., and is providing training to Pakistani scientists and engineers in the areas Organic Electronics and Photovoltaics. The facilities are available for the fabrication & characterization of organic junction diodes, sensors, organic photodiodes, organic field effect transistors, organic memories, solar cells, etc. These include: Keithley source measurement unit 236 for low current characterization and 228 unit for high current measurements, Keithley 196 61/2 digit DMM, DSP lock-in-amplifiers, LCR meter, LUX meter, Temptronic power supply, Karlsuss (PM5) Probe Station for room temperature to high temperature measurement, low temperature (down to 77K) characterization setup based on Janis cryogenics LN dewar, vacuum thermal evaporator, etc.

High Power LASER Laboratory
The high power laser lab at the faculty of engineering sciences is currently engaged in research projects in the fields of laser ablation, laser micromachining and laser materials processing. The laboratory facilities include a Quantel Brilliant B high power Q-switched Nd:YAG Laser of energy of 950 mJ at its fundamental wavelength of 1064 nm.

Scanning Probe Laboratory
Research facility in the field of scanning probe microscopy is under construction in collaboration with nanomagnetics instruments, UK. At present lab contains nanomagnetics multipurpose microscope which can be used to perform scanning Hall probe microscopy, scanning tunneling microscopy and AFM.

This lab also contains homemade NDE system based on Hall probe for micro meter spatial resolution using current induction method. Image processing software and computer interface with Intel core 2 duo CPU.

Lithography Lab

Providing the quality education to the students, GIK Institute has developed a clean room facility for the semiconductors stream students where they have the MJB3 lithographic setup. With this a spin coater and lock-in amplifier is also provided in the lab. For the development of the samples, fume hood and hot plate with magnetic stirrer are also present in the lab.

Semiconductor Lab

The semiconductor laboratory is an integral part of the modern curriculum in Faculty of Engineering Sciences. It allows students to apply what they have studied in semiconductor devices course. They learn how to find the properties related to semiconductor devices and explore the device fabrication. The experiments like resistivity measurement, conductivity type and carrier concentration are addressed. Students are given demonstrations on the photo lithography machine. For characterization of the material, they are given demos on the SEM, EDS, XRD and optical Microscopy. For the device fabrication they are given demos on thermal vacuum evaporator and spin coater. Students are further given demos on probe station and lock-in amplifier for device characterization. Experiments on solar cell I-V characterization and thermoelectric generator are also conducted in this lab. Major equipment includes Hall effect board (P/nGe), Hall effect board (Zn/Cu), Universal Measuring Amplifier and support accessories.

Advance Photovoltaics Research Laboratories

These labs were founded in 2015 by Prof. Dr. Muhammad Hassan Sayyad and funded by Higher Education Commission (HEC) of Pakistan. The labs were established for the development of next generation solar cell technology and computational design of molecular systems for efficient harvesting of solar energy as part of the collaborative research project entitled "New approaches for lower cost, longer stability, and higher efficiency of dye-sensitized solar cells (DSSCs)" between the Faculty of Engineering Sciences, Ghulam Ishaq Khan Institute (GIKI) of Engineering Sciences and Technology and Department of Electrical Engineering, Center for Advanced Photovoltaics, South Dakota State University (SDSU), Brookings, USA under the Pakistan-U.S. Science and Technology Cooperation Program Phase 5. These labs

include:

Dye-sensitized solar cell fabrication laboratory.

Keithley 4200 Semiconductor Characterization System (SCS) based solar cell IV & CV characterization laboratory.

Pulsed Nd:YAG and 1 GHz Storage oscilloscope based solar cell transient photovoltage and photocurrent characterization laboratory.

TD-DFT based simulation laboratory for the design of molecular systems for efficient solar energy harvesting.

Nanotechnology Research Lab (Nanotech Lab)

A well-equipped lab fosters material design along with synthesis and fabrication of electrodes such as thin films, porous electrodes, anodes, and cathodes. Several material synthesis methods such as hydrothermal, solvothermal, sonochemical, spin coating, and electrodeposition are available. By utilizing these techniques, the lab focuses on the design and optimization of novel porous and crystalline materials, composites, and thin films. Facilities include fume hood, muffle furnace, hot plate, centrifuge, spin coater, filtration unit, ultrasonic bath sonicator and optical microscope. Furthermore, this lab is well-furnished with a setup of electrical transport measurement containing source meter (Kiethley), piccoammeter (Kiethley), lock-in amplifier SR830 DSP, gaussmeter, power supply and autotuning temperature controller 330 (Lakeshore). These facilities provide access to the characterizations of optical, electrical and optoelectronic properties, spintronics, quantum electronics, sensors, transistors, micro-, meso-, and nanoscale devices.

ZENTECH Research Lab (ZENTECH Lab)

ZENTECH lab is equipped with GAMRY potentiostat instrument (Reference 3000) to study the electrochemical performance of various electrodes and devices. The lab offers the mandatory equipments and facilities to fabricate the current and next generation energy conversion as well as energy storage devices

including solar cells, supercapacitors, batteries, fuel cells, and battery-supercapacitor hybrids. Several electrochemical processes (such as hydrogen production, photoelectrochemical and water splitting) can be explored. Further, research in semi-empirical and theoretical approaches a part of research including machine learning, density functional theory (DFT) and data analytics. The available state-of-the-art facilities provide a platform for the learners at undergraduate and graduate level.

Research Groups

1.Inter-disciplinary Machine Learning Initiative (IMLI)

Main research area(s) in Inter-disciplinary Machine Learning Initiative (IMLI) group includes:

Exploring Customer/Driver Fraud Detection using Machine Learning algorithms with Careem.

The research in the above-mentioned areas is supported by Modelling and Simulation Lab.

One research work on Fraud Detection is being carried out by the group with Careem. Selim Turki,

Director Data Analyst is the focal person for industrial collaboration.

Researchers

Dr. Naveed Razzaq Butt (naveed.butt@giki.edu.pk)
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Mr. Asif Ahmad (asif.ahmad@giki.edu.pk)

2.Advanced Photovoltaics and Energy Storage

Main research area(s) in Advanced Photovoltaic and Energy Storage include:

-Advanced Photovoltaic and Energy Storage

The advanced photovoltaics and energy storage research group is a dynamic and innovative team dedicated to advancing renewable energy conversion and storage technologies. Our group members are at the forefront of developing cutting-edge solar cell materials and designs to harness the power of the sun efficiently. In parallel, our work in supercapacitors and batteries aims to revolutionize energy storage solutions, enabling grid stability and renewable energy integration.

This group has international collaboration with institute of functional nano & soft materials (FUNSOM), Soochow University, China, Fudan University, China and London South Bank University, UK.

Researchers

Dr. Muhammad Zahir Iqbal (zahir@giki.edu.pk)
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Mr. Sajid Khan (Sajid.khan@giki.edu.pk)
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Ms. Asma Khizar (ges2267@giki.edu.pk)
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3.Computational Mathematics

Main research area(s) in the Computational Mathematics group includes:

- Computational Mathematics

Researchers

Prof. Dr. Sirajul Haq (siraj@giki.edu.pk)
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Mr. Mehboob Alam (ges2214@giki.edu.pk)

4.Hyperspectral Imaging and Remote Sensing

Main research area(s) in Hyperspectral Imaging and Remote Sensing Research Group includes:

- Hyperspectral Imaging and Remote Sensing

This group has international collaboration with Wits University, South Africa.

Researchers

Dr. Asad Mahmood (asad.mahmood@giki.edu.pk)
Dr. Taj Khan (taj.khan@giki.edu.pk)

5.Nanotechnology

Main research area(s) in NanoTech Research Group includes:

- Research related to Nanotechnology

This research group specializes in the synthesis of nanomaterials and the fabrication of nanoelectronic devices, primarily focusing on Field-Effect Transistors (FETs). The work involves precise material characterization and testing to harness the potential of nanoscale materials for various applications, from advanced sensors to cutting-edge electronics. This research group also delves into chip design, fabrication and integration of their nanoelectronic components.

This group has international collaboration with Sejong University, South Korea. This group also organized the following conferences / workshops:

"1st International Workshop/Symposium on Quantum Technology (July 20th, 2023)"

"Workshop on "Advanced Experimental Techniques" (Aug, 2022)".

Researchers

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Ms. Misbah Shaheen (ges2302@giki.edu.pk)

6.Quantum Engineering

Main research area(s) in Quantum Engineering Research Group includes:

Research related to Computational Physics and Quantum Engineering

The group does pioneering research in III-V-based light-emitting diodes and laser diodes in Pakistan. Over a dozen research students have graduated from the research group so far. The research group has won millions (in PKR) of research funding through various funding agencies. The alumni of the research group are pursuing their careers in exciting fields, globally. Our research interests include (but not limited to):

Wide bandgap Materials and Devices
Engineering Quantum Wells and Quantum Devices
Solid-state lighting
Energy conservation
Visible light communication
High-electron Mobility Transistor

This group has international collaborations with the following institutions:

RIKEN, Japan
Chonnam National University, South Korea
Hanyang University, South Korea
Zhengzhou University, China
Institute of High Pressure Physics, Poland

This group conducts Continuous Professional Development (CPD) workshops annually.

Researchers

Dr. Muhammad Usman (m.usman@giki.edu.pk) (Group Lead)
Dr. Masroor Hussain (hussain@giki.edu.pk)
Dr. Shanza Rehan (shanza.rehan@giki.edu.pk)
Dr. Usman Habib (usman.habib@giki.edu.pk)
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Ms. Asima Sarwar (PhD Student)
(asima.sarwar@giki.edu.pk)
Mr. Anique Ahmed (PhD Student)
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Ms. Laraib Mustafa (MS Student)
(ges2274@giki.edu.pk)
Ms. Wagma Hidayat (MS Student)
(ges2322@giki.edu.pk)
Mr. Jamshad Bashir (MS Student)
(ges2320@giki.edu.pk)
Ms. Syeda Wageeha Shakir (MS student)
(ges2323@giki.edu.pk)
Ms. Iqra Anjum (MS student) (ges2319@giki.edu.pk)
Ms. Anum Ali (MS student) (ges2323@giki.edu.pk)
Mr. Irshad Ali (PhD Student) (gmm2353@giki.edu.pk)
Ms.Haleema Sadia(MS Student)
(gmm2399@giki.edu.pk)

7.HBL Center for Blockchain & Applied Research

Main research area(s) of HBL Center for Blockchain & Applied Research Group includes:

- Blockchain

This group has industrial collaboration with HBL, Pakistan. This group organized Blockchain 101 Workshop - Hands-on development training on blockchain.

Researchers

Dr. Fahd S. Khan (fahd.khan@giki.edu.pk)
Mr. Maaz Khan
Mr. Taimoor Hayat

8. Optoelectronics

Main research area(s) of Optoelectronics Research Group includes:

Modeling, simulation and experimental characterization of optoelectronic devices including transmitters (LED, LD, VCSEL), Modulators (MZM, Phase Modulator), Receivers (pin photodiode, avalanche photodiode), Solar cells (heterojunction, perovskite, quantum dot)

Researchers

Dr. Usman Habib (usman.habib@giki.edu.pk)
(Group Lead)
Dr. Nasir Javed (nasir.javed@giki.edu.pk)
Mrs. Nadia Anwar (PhD student)
(ges2156@giki.edu.pk)
Ms. Syeda Wageeha Shakir (MS student)
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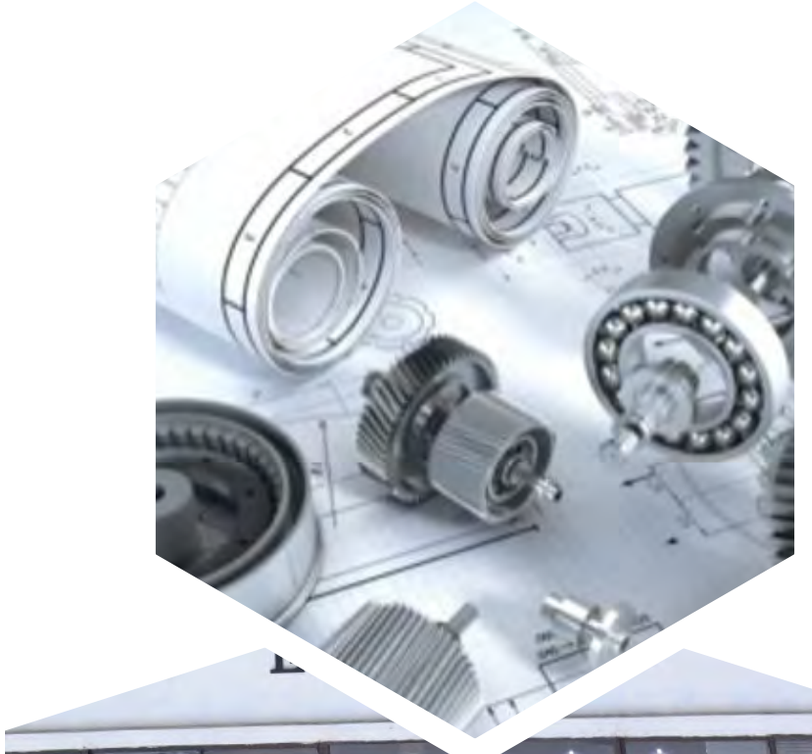
Ms. Iqra Anjum (MS student) (ges2319@giki.edu.pk)
Ms. Anum Ali (MS student) (ges2323@giki.edu.pk)

FACULTY OF MECHANICAL ENGINEERING



Dean

Dr. Taqi Ahmad Cheema

PhD, Kyungpook National University, South Korea

FACULTY

Wasim Ahmed Khan, PhD, University of Sheffield, UK, Chartered Engineer, FIMechE
Muhammad Asif, PhD, Hanyang University, South Korea
Waqas Akbar Lughmani, PhD Loughborough University, UK
Massab Junaid, PhD, GIK Institute, Pakistan
Ali Turab Jafry, PhD, Sungkyunkwan University, South Korea
Abid Imran, PhD, Hanyang University, South Korea
Arsalan Arif, PhD, Hanyang University, South Korea
Asif khan, Dongguk University, South Korea
Muhammad Bilal Khan, PhD, Beijing institute of Technology China.
Taimoor Hassan Shah, PhD, Scuola Superiore Sant'Anna, Italy
Faheem Ahmad, MS, INHA University, South Korea
Muhammad Qasim Zafar, MS, UET Lahore, Pakistan
Muhammad Shoaib, MS, KAIST, South Korea
(Faculty on Study Leave)
Khalid Rahman, PhD Jeju National University South Korea.
Ghulam Hussain, PhD, Nanjing University, China.
Ahmad Abbas, PhD, GIK Institute, Pakistan

FACULTY OF MECHANICAL ENGINEERING

Engineering is a creative profession concerned with combined human, material, and economics to satisfy the needs of a society. Mechanical engineering is one of the broadest and most versatile of the engineering professions. In Pakistan, GIK-Institute is the leader in high quality mechanical engineering education.

The prime objective of the educational program at the GIK- Institute is to prepare students for professional practice in an area of rapidly advancing technology. It strives to develop independence, creative talent, and leadership as well as the capability for continuing professional growth. Mechanical engineering graduates need in-depth knowledge of the latest developments in their fields, and should be conversant with the current research and development activities in the advanced countries. They should also receive a good measure of exposure to the problems encountered by our developing industrial infrastructure striving for techniques and strategies to cope with them.

Several broad areas of professional concentration for mechanical engineering graduates are: energy conversion and conservation, environmental engineering, manufacturing and materials processing, mechanics of materials, additive manufacturing, mechanical engineering design, transportation systems, robotics, artificial Intelligence, structural health and condition monitoring, energy harvesting, computational mechanics and system dynamics and control. Further focused areas of machine learning, IOT and blockchain are also being explored in conjunction with Industry 4.0.

Graduate Program

Graduate program can be pursued in the Faculty of Mechanical Engineering (FME) specializing in one of the following areas of engineering:

I. Design and Manufacturing

ii. Thermo-Fluids

iii. System Dynamics & Control Systems

iv. Computational Mechanics

The FME offers courses leading to both Master (MS), and Doctor of Philosophy (PhD) degrees in Mechanical Engineering. The graduate course curriculum in Faculty of Mechanical Engineering gives an excellent opportunity to the students to improve their employment prospects and keep abreast of today's cutting-edge technology.

Phd Curriculum

1. Title of degree program: PhD in Mechanical Engineering

2.graduate Program Objectives (PO)

Following is the **PhD** program objective of FME:

i. Graduates contributing to academia and/or industry through knowledge sharing and problem solving.

ii. Graduates performing in a responsible and professional manner.

iii. Graduates contributing to academia and/or industry through knowledge sharing and problem solving.

3. Graduate Program Learning Outcomes (GPO):

Students while engaging in mechanical engineering and allied disciplines shall have an ability to:

i. apply scientific principles to solve engineering problems.

ii. analyze and investigate processes and/or system(s).

iii. design and develop solutions using scientific tools and/or techniques.

İV. communicate professionally in written, oral, and/or graphical forms.

V. contribute to the body of knowledge.

4. Definition of Credit Hour (CH): The credit hours assigned to a theory or a laboratory course is determined by the contact hours allocated to it per week throughout a semester. For a theory course, one credit hour is equivalent to one contact hour of lecture per week, and for a laboratory course, three contact hours of practical work per week constitute one credit hour.

5.Degree Plan: The PhD student will have to take six courses, generally each of three credit hours and complete his/her dissertation. The courses to be taken by the student will be decided by his/her advisor and approved by the Dean of Graduate School. Four out of the six courses must be from the list of FME courses, and the remainder may be from other Faculties. For the award of PhD degree in Mechanical Engineering, a student must complete 42 credit hours, the distribution is as follows:

Faculty Courses	Other Faculty Electives	Dissertation	Total
Minimum 4 courses (12 credit hours)	Minimum 4 courses (12 credit hours)	18 CHs	42 CHs

MS CURRICULUM

1. Title of degree program:

MS in Mechanical Engineering

2. Graduate Program Objectives (PO):

Following are the **MS program** objectives of FME:

i.Graduates practicing in Mechanical Engineering and allied disciplines or conducting research.

ii.Graduates performing in a responsible and professional manner.

3. Graduate Program Learning Outcomes (GPO)

Students while engaging in mechanical engineering and allied disciplines shall have an ability to:

i. apply scientific principles to solve engineering problems.

ii. analyze and investigate processes and/or system(s).

iii. design and develop solutions using scientific tools and/or techniques.

iv. communicate professionally in written, oral, and/or graphical forms.

4.Definition of Credit Hour (CH):

The credit hours assigned to a theory or a laboratory course is determined by the contact hours allocated to it per week throughout a semester. For a theory course, one credit hour is equivalent to one contact hour of lecture per week, and for a laboratory course, three contact hours of practical work per week constitute one credit hour.

5.Degree Plan:

The courses offered by the FME are categorized as core courses, faculty electives and other-faculty electives. For the award of MS degree in Mechanical Engineering, student must complete 30 credits hours, (8 courses of 3 credits each) and a thesis of 6 credits. The courses distribution is as follows:

Core Courses	Faculty Electives	Other-Faculty Electives	Thesis	Total
3 courses (9 CHs)	3 courses (9 CHs)	Maximum 2 courses (6 CHs)	6 CHs	30 CHs

Course Details:

The details of the **core courses** offered at the FME are as follows:

ME514 - Advanced Stress Analysis (3-0-3)

Stress and strain tensors, alternative yielding criteria and differential equations of deformable bodies, elastic-plastic deformations, creep: time-dependent deformation, fatigue: progressive fracture, contact mechanics, fracture mechanics, stress concentration factors, specialized topics in structural mechanics, and case studies on mechanical design.

ME568 - Elements of Vibration and Feedback Control (3-0-3)

Mathematical modelling of dynamical systems, Laplace and Fourier transformations, frequency response, general forced response, multiple degrees of freedom systems, feedback control, and performance of feedback control system

ME523 - Mass, Momentum and Energy Transport (3-0-3)

Introduction to mass, momentum and energy transport, The gradient principle, Conservation laws of transport, Material derivative, Reynold's transport theorem, continuity, linear and angular momentum equations, Applications to compressible, incompressible, inviscid and/or viscous flows, Navier-Stokes's equations, Boundary layers, Internal and External flows, Modes of Energy Transfer, Conservation of Energy Requirement, Energy transfer by conduction, Conduction Rate, Equation, analytical and numerical solution of heat conduction, Transient conduction, The Convection Boundary Layers, The Boundary, Layer Equations, Similarity solutions, Energy transfer by radiation, laws of radiation, radiation exchange between surfaces, the view factor, Physical origin and rate equations, governing laws, conservation of species, mass transport in stationary and nonstationary medium, multicomponent mass transport, pool, nucleate, film-pool boiling, condensation, film and dropwise condensation, mass transfer with and without chemical reactions.

The details of the faculty electives offered at the FME are as follows:

ME506 - Continuum Mechanics (3-0-3)

General aspects, Basic assumptions and continuum hypothesis, Mathematical tools, Cartesian tensors, Curvy-linear coordinate system in Tensors, Kinematics of continuum, Motion, stresses, deformation, Fundamental laws of continuum mechanics, Theory of constitutive equation, Basic material laws, Applications to solids and fluids

ME511 - Advanced Dynamics (3-0-3)

Hamilton's principle, Generalized variables, Lagrange's equations, Rigid body dynamics and systems with gyroscopic effects on spinning shafts and critical speeds, Gyro compass, inertial navigation, Vibration of system with time-varying and non-linear characteristics, Hamilton's principle applied to distributed systems and systems with electro-mechanical transducer components, Numerical Methods

ME512 - Advanced Solid Mechanics (3-0-3)

Physical elements of deformation and fracture, Elements of continuum mechanics and thermodynamics, Identification and rheological classification of real solids, Linear elasticity, Thermo plasticity, Viscoelasticity, plasticity, visco-plasticity, Damage and crack mechanics.

ME519 - Experimental Stress Analysis (3-0-3)

Transformation of stresses, Brittle coatings, Photo elasticity, Strain gauge analysis, Moiré fringes, Grid methods, Analogies and applications on static and dynamic problems

ME517 - Theory of Vibration (3-0-3)

Review of 1 DOF with a forced response, Review of 2 DOF with a forced response, Design for vibration suppression and control, Matrix method for multi-degree of freedom systems, Distributed systems, Dynamic finite element method, Vibration measurement, testing and experimental modal analysis, and Non-linear vibrations

ME521 - Intermediate Fluid Mechanics (3-0-3)

Continuum properties, Control volume formulation of conservation laws, Control volume field equations, Euler equation, NS and Thermal equations, Exact solutions, Vorticity and circulation, Inviscid flow

considerations, Boundary layers measurement techniques

ME531- Advanced Conduction and Radiation Heat Transfer (3-0-3)

Steady and unsteady multidimensional conduction in different geometrics, Methods of solutions, SOV, integral transformation, numerical means, Electromagnetic background, Interaction of radiation with homogenous matter and interfaces, Natural Convection, Laminar boundary layer, Blackbody radiation, Radiation from real surfaces, Radiative energy, View factor and black body exchange.

ME532 - Advanced Convection Heat Transfer (3-0-3)

Equation of motion, Condensation, Boiling, Formulation of laminar, free and forced convection, Methods of solutions, The analogy between heat and momentum transfer, Reynolds, Taylor, Prandtl and Martinelli analogies

ME533 - Advanced Thermodynamics (3-0-3)

Thermodynamic terminology, First law for a closed and open system, Second law for closed and open systems, Lost available work, Cycles, Entropy generation and energy destruction, Single and multi-phase systems, Chemically reactive systems

ME581 - Manufacturing Systems (3-0-3)

Introduction, Overview of manufacturing processes, Machine tools and manufacturing equipment, Process planning, Production planning and control, Scheduling, Design of manufacturing system, Operation of a manufacturing system, and Virtual manufacturing systems

ME505 - Parameter Estimation (3-0-3)

Estimation of parameters in ordinary and partial differential equations, Probability and Statistics, Least squares and other estimators, Sequential methods, and Optimal experimental design

ME513 - Theory of Shells and Plates (3-0-3)

Torsion, pure bending, transverse loading, transformation of stress and strain, singularity function, deflection by integration, deflection by moment area method, Castigliano's theorem, Euler's formula for columns, Secant formula for columns, Theory of plates and shells

ME515 - Finite Element Method (3-0-3)

Introduction to FEM, Stiffness method and plane truss, 2-D stress analysis by FEM, Energy, variational principles and Ritz technique, Galerkin's Approach, Elements based on assumed displacement fields, Isoparametric formulation, Coordinate transformation, Topics in element formulation and use, Solids revolution, Bending of flat plates, 3-D stress analysis, General field problems, and Computer codes

ME516 - Applied Finite Element Analysis (3-0-3)

Direct Stiffness Method, Types of elements (1D, 2D and 3D), Spring and bar elements, Truss elements, Axisymmetric elements, Beam elements plate elements, Serendipity elements, Langrangian elements, V and V Types of boundary conditions, 2D and 3D analysis, Mesh convergence, Refinement techniques.

ME518 - Mechanics of Composite Materials (3-0-3)

Nomenclature and classification, Fundamental equations, Constitutive equations, Symmetric, asymmetric and other characteristic layering setups, Failure theories, Thermal stresses, and Damage

ME522 - Viscous Flow (3-0-3)

Introduction, Properties of fluids, Boundary conditions, Fundamental equation of compressible viscous flow, Dimensionless parameter, Solution to Newtonian viscous flow equations, Laminar boundary layers, Stability of laminar flows, Incompressible turbulent flows, Compressible boundary layer flows, Finite difference analysis
Digital computer solutions

ME524 - Advanced Computational Fluid Dynamics (3-0-3)

Introduction, Partial differential equation, Basics of finite difference method, Concepts of error, Consistency and stability, Momentum and energy equations, Diffusion equations, Turbulence modelling, Boundary layer computational methods, Hyperbolic equations, and Grid systems

ME525 - Fluid Mixing and Separation (3-0-3)

Introduction to fluid mixing technology, Equipment and correlation, Mechanical design of fluid mixers, Heat transfer in agitated vessels, Principles, methodologies and equipment of Solid-liquid and liquid-liquid separation, and Cyclone separators

ME534 - Boiling and Condensation Heat Transfer (3-0-3)

Thermodynamics of vapour/liquid systems, the Basic process of boiling, Pool boiling, Convective boiling, Single phase heat transfer, Onset of subcooled boiling, Saturated boiling heat transfer, Critical heat flux in forced convective flows, Condensation and evaporation at a liquid-vapour interface, Film and dropwise

condensation, Augmentation techniques

ME535 - Industrial Air Conditioning and Refrigeration (3-0-3)
Summer and winter air conditioning load calculation, Air conveying and distributions, Fans and duct design, Diffusion apparatus for producing comfort in summer, All-year air conditioning methods and equipment, Automatic control for air conditioning system, Refrigeration load, Selection of all units and specification of equipment, Methods of development for the design work, Methods of development studies in air conditioning industries.

ME536 - Internal Combustion Engine (3-0-3)
Properties of working fluid, Scavenging in 2-stroke engines, Supercharging, Modeling real engine flow and combustion processes, and Engine operating characteristics

ME537 - Fluidized Bed Combustion (3-0-3)
Combustion thermodynamic, Chemical kinetics, Reaction rate, Explosion in gases, Detonation, Laminar and turbulence flames in pre-mixed gases, Diffusion flames, Theory of thermal ignition, Combustion of particles

ME538 - Thermal Power and Refrigeration Systems (3-0-3)
Review of thermodynamic processes in buildings, Fundamental physical concepts, Air-conditioning systems, Moist air properties and conditioning processes, Comfort and health, Heat transmission in building structures, Space heat load analysis, Solar radiation, Fluid flow, pumps, and piping design, Cooling load analysis, Fans and building air duct design, and Refrigeration

ME552 – Robotics (3-0-3)
Review of Robotics I, Forward-inverse kinematics, Jacobians velocities and forces in robotic manipulators, Manipulator mechanism design, Linear control of manipulators, Force-control of manipulators

ME553 - Design of Machine Tools (Technical Elective) (3-0-3)
Types of machine tools, General requirements in the design of machine tools, Geometry and performance of cutting tools, Basic theories of metal cutting, Actuators and drive systems, Slide-ways, Spindle and spindle bearings, Control and operating devices, Cooling systems, Work holding devices, Machine tool structures, Machine tool, and dynamics

ME554 - AI in Design and Manufacturing (Technical Elective) (3-0-3)
Application of artificial intelligence to design and manufacturing, Principles, strengths and limitations of existing techniques, Knowledge representation issues and techniques, Prologue expert system and machine learning

ME555 - Joining of Advanced Materials (Tech Elective) (3-0-3)
Introduction to joining, mechanical fastening, Mechanical fastener and joining methods, Adhesive bonding, Adhesives and their bonding processes, Welding, Joining advanced metals, Alloys, and inter-metallics, Joining of ceramics and glasses, polymers composite materials, dissimilar material combination, Residual stresses in weldments

ME556 - Quality Assurance (Tech Elective) (3-0-3)
Genesis of total quality control, Planning process, Process management, Employee participation, Quality control review, and Relevant standard

ME557 - Engineering Plasticity (3-0-3)
Overview of Stress and Strain, Macroscopic Plasticity and Yield Criteria, Plastic Instability, Temperature and Strain Rate Dependence, Analytical Analysis of Forming Forces, Formability, and Advanced Forming Processes

ME562 Advanced CAD/CAM (Tech Elective) (3-0-3)
Overview of existing CAE systems, Architecture of high-performance graphic displays in engineering workstations, Orthographic and perspective display transformations, Parametric representation of curves and surfaces, Elementary differential geometry, interactive graphics, Bi-cubic surface paths, Image generation, Numerically controlled tool paths, Solid modelling, Advanced research topics, Interpreters and compilers, Virtual reality, Industrial CAD, Internet of Things (IoT), Project management for software development.

ME563 - Mechanism Design (Tech Elective) (3-0-3)
Kinematics and dynamic characteristics of planar and spatial mechanisms, Vector and graphical methods for kinematics analysis, Introduction to graphical and computer methods for kinematics synthesis of mechanisms, Methods for dynamic analysis of mechanisms, Applications from industrial machine systems and robotics manipulators, Multi-Body Dynamics

ME564 - Automation and Control (Tech Elective) (3-0-3)
Architecture of industrial automation systems, Symbolic description of process behaviour, Measurement and instrumentation, Signal conditioning and data acquisition, Pattern classification and clustering, in process monitoring and sensor fusion, Theory and techniques of high-level control, Strategies and decisions at a symbolic level, Supervised and unsupervised learning, Neural networks, Rule-based control, Fuzzy control, Case studies on robots, vehicles, and various physical plants, Emphasis on the bridge between physical and symbolic domains

ME565 - Tribology (Tech Elective) (3-0-3)
Theories of friction, Mechanism of wear, Adhesive, abrasive, corrosive and other retypes of wear measurement, Properties of lubricants, Solid film lubrication and Boundary lubrication, Hydrodynamic lubrication, Reynolds equation, Types and selection of bearings Design procedure and performance evaluation of bearings, Energy equation and effective viscosity concept, Hydrostatic lubrication, Surface treatments, Elasto-hydrodynamic lubrication, Extreme pressure lubrication.

ME566 - Mechatronics System Design (3-0-3)
Mechatronics, Sensors and Actuators, Mechanical and Electrical Drives, Controllers and Control Algorithms, Embedded Systems, Electromechanical Systems, Energy Conversion, Basics of Electromagnetism, Finite Element Modeling of Electromagnetic Systems, Design of Linear Actuators and CAD Modeling

ME567 - Applied System Dynamic and Control
Modelling of dynamics of mechanical systems, Review of classical control, Control design by frequency response methods, State variable techniques, Design of control in state space, Optimal/robust control theory, Design of controller in the discrete domain and practical case studies, Control laws amenable to mechanical engineering systems

ME595 Solar Energy Utilization (3-0-3)
Solar Energy Conversion: Present needs and resources, comparison with other renewable energy resources, thermal conversion, limitations of solar energy ,Solar Radiation: Physics of Sun and its Energy Transport, Thermal radiation, Sun-Earth geometric Relationship, Estimation of terrestrial solar radiation, Models based on Long-term measured horizontal solar radiation, measurement of solar radiation, Solar Thermal Collector: Radiative properties and characteristics of materials, Flat- Plate collectors, Tubular solar energy collector, experimental testing of collector, concentrating solar collectors, parabolic trough concentrator, compound-curvature solar concentrators, central receiver collector, Fresnel reflectors and lenses, Thermal energy storage and transport: Thermal energy storage, types of TES, Design of storage system, energy transport subsystems, Solar Heating systems: Calculations of heating and Hot-Water Loads in Buildings, Solar Water-Heating Systems, Liquid-Based Solar Heating Systems for Buildings, Solar Air Heating Systems, methods of modeling and design of solar heating systems, Long-term performance of solar heating systems, Solar Cooling and dehumidification: Solar space cooling and refrigeration, solar desiccant dehumidification, Passive Solar Heating, cooling and delighting: passive space heating systems, passive space cooling systems, delighting design fundamentals, Solar Thermal Power: Thermodynamics power cycle, Design of parabolic trough-based power plants, parabolic dish systems, Sterling cycle, central receiver tower systems, Central receiver system design, solar distillation of saline water, Non-converting solar ponds.

ME611 - Fracture Mechanics (3-0-3)
Introduction to fracture mechanics, Types of cracks, Fracture toughness, Stress intensity factors, Crack opening modes, Singular stress fields, Crack tip stress fields, Ductile to brittle transition, Linear elastic and elastic-plastic fracture mechanics, J-integral, Post yield fracture mechanics, Failure theories, Fracture mechanics in design, Experimental and analytical procedure in fracture mechanics, Case studies: ships, aerospace, and nuclear reactors

ME612 - Finite Element Method in Manufacturing Processes (3-0-3) Pre-requisite(s): ME 515
Fundamental principles, One-dimensional material nonlinear problems, Deformation in general motions, Plasticity analysis, Creep analysis, Small deformation elasto-viscoelastic analysis, Large deformation viscoelastic analysis, Application of FEM to metal forming processes, Application of FEM to metal cutting, Application of FEM to AM

ME621 - Boundary Layer Theory (3-0-3) Pre-requisite(s): ME 521
Navier-stokes equations, Derivation of boundary layer equations for two-dimensional flow, General properties of the boundary layer equations, Exact solutions of the steady-state two-dimensional boundary layer equations, Boundary layer control, Thermal boundary layers, Fundamentals of turbulent flow, Turbulent flow through pipes and along a flat plate, Approximate

methods for turbulent boundary layers. Turbulent jets

ME622 - Hydrodynamic Stability (3-0-3) Pre-requisite(s): ME 521
Introduction to hydrodynamic stability, Thermal instability, Centrifugal instability Instability of parallel shear flows

ME623 - Two-Phase Flow (3-0-3) Pre-requisite(s): ME-521 and ME-522
Liquid-Solid, Liquid-vapor, Solid-gas flows, Flow regimes of liquid-vapour flows, Pressure drop predictions, Strokes flow, Drag and lift, Flow regimes of Fluidized beds and relevant statistical analysis, Bingham flow, Dispersed phase flows, Energy and momentum coupling, Reynolds transport theorem, Combustion of droplets or particles, Numerical and experimental methods

ME624 - Turbulence (3-0-3) Pre-requisite(s): ME 521 and ME 523
Nature of turbulence, Turbulent transport of momentum and heat, Dynamics of turbulence, Examples of turbulence flows, Statistical description of turbulence, Spectral dynamics

ME6 Mechanics of Laminated Composites (3-0-3)**
Classification of composites, Derivation of elasticity tensor, Classical Lamination Theory (CLT), First Order Shear Theory (FOST), Higher Order Shear Theories (HOST), Laminated composite plates and shells, Sandwich panels with composite face sheets, Development of classical beam theory

ME613 - Metal Forming Mechanics (3-0-3)
Theory of Plasticity, Prediction of Instability in Plastic Regime, Flow Stress and Strain Rate Dependence, Force and Stress Analysis under Plastic Flow, Redundant Work, Forming Limits

ME625 - Aerosol Technology (3-0-3)
Introduction and Properties of Gases, Uniform Particle Motion, Particle Size Statistics, Straight line Acceleration and Curvilinear particle Motion, Adhesion of Particles, Brownian Motion and Diffusion, Thermal and Radiometric Forces, Filtration, Sampling and Measurement of Concentration, Respiratory Deposition, Coagulation, Condensation and Evaporation

ME626 Microfluidic Systems (3-0-3)
Concepts in microfluidics, Governing equations, Flow solutions and microfluidic operation, Hydraulic Circuit Analysis, Mixing and Separation, Fabrication Techniques in Microfluidics, Digital microfluidics, Paper-based microfluidics, Applications

ME695 - Advance Solar Thermal Engineering (3-0-3)
Solar Collectors, Solar Chimneys, Solar Thermal Energy Storage, Solar Ponds, Solar Desalination, Green Buildings, Solar Power Generation

LABORATORIES AND COMPUTING FACILITIES :

LABORATORIES AND COMPUTING FACILITIES

FME has managed to acquire a versatile blend of research equipment and facilities in the labs for the students so they can cope up with the fast-changing technological requirements. These provide the opportunity to learn and understand the concepts of engineering and constructively transform them to practical use. Some of FME's laboratory facilities are listed below:

1. Computational Mechanics Lab
2. Heat Engine Lab
3. Fluid mechanics Lab
4. Heat Transfer, Refrigeration and Air conditioning Lab
5. Vibrations Dynamics and Control Systems (VDC) Lab
6. Mechatronics Design Lab
7. Energy and Environment research Lab
8. CNC Industrial Lab
9. CNC training Lab
10. Natural Fluids Refrigeration Center (NFRC)
11. Sub-sonic wind tunnel Lab
12. Solid Mechanics Lab
13. Mechanical Workshop
14. Advanced Welding Lab
15. Experimental Stress Analysis Lab
16. Composite Structures Lab (CSL)
17. Electrical Machines and Drives Lab
18. Printed Electronic Research Lab

Details of Labs

The details of the Labs are given below

Lab 1:

Laboratory Title	Computational Mechanics Lab
Location and area	Ground Floor
Objectives	To teach Engineering Software and computational tools and apply them on theories of mechanical engineering for research and development.
Courses taught	Computational Fluid Dynamics, Finite Element Analysis, Analysis and post processing related to instrumentation, mechanics of solids, system dynamics and control, theory of machines, Multibody Dynamics.
Software available if applicable	ANSYS, ICEM, CFX, Matlab, CREO, Solid works, Microsoft office, MSC Motion and StructureBundle.
Major Equipment/Apparatus	High performance computers, printers and multi-media
Safety regulations	Do not use software/computers without proper knowledge.

Lab 2:

Laboratory Title	Heat Engine Lab
Location and area	Ground Floor
Objectives	To perform research on internal combustion engines, emission analysis using conventional and biofuels.
Courses taught	Advanced Internal Combustion Engines
Software available if applicable	Indicom, Comsol, Solid works
Major Equipment/Apparatus	Steam Motor & Energy Conversion Test Set, AVL Gas Analyzer & Data Acquisition System(4000 NOX), Water Distillation Unit with Automatic Gas On-Off system, LaserEngraving Machine, Heating Plates Press Machine Temp Range
Safety regulations	As per Environment, Health, and Safety rules of FME

Lab 3:

Laboratory Title	Fluid Mechanics Lab
Location and area	Ground Floor
Objectives	Research in Fluid Mechanics
Courses taught	Intermediate fluid mechanics, Viscous flow, Boundary layer theory, Two phase flow, Turbulence,Mass, Momentum and Energy Transport, Aerosol technology and Micro fluidics
Software available if applicable	ANSYS, CFX, Matlab, EES, MathCAD etc.
Major Equipment/Apparatus	Venturi meter apparatus, Center of pressure apparatus, Pressure drop in valves and pipe fittings apparatus, Office apparatus, Series parallel pump apparatus, Reynolds apparatus, Characteristics curves of pumps apparatus, Bernoulli's apparatus, Francis turbine, Kaplan turbine, Pelton turbine
Safety regulations	As per Environment, Health, and Safety rules of FME

Lab 4:

Laboratory Title	**Heat Transfer, Refrigeration and Air conditioning Lab**
Location and area	Ground Floor
Objectives	To conduct research on heat and mass transfer, refrigeration and air-conditioning applications.
Courses taught	Boiling and condensation heat transfer, Advanced conduction and Radiation heat transfer, Advanced convection heat transfer, industrial Refrigeration and Air Conditioning, Advanced Thermodynamics, Mass, Momentum and Energy Transport, Thermal Power and Refrigeration Systems
Software available if applicable	Matlab, ANSYS, Pro-Engineer
Major Equipment/Apparatus	Conduction, convection, radiation apparatus, vapor compression and absorption cycles apparatus, heat exchangers, Film & Drop Wise Condensation Unit, Modular Air Flow Apparatus (Drag Measurements)
Safety regulations	As per Environment, Health, and Safety rules of FME

Lab 5:

Laboratory Title	**Vibration Dynamics and Control System (VDC) Lab**
Location and area	2nd floor
Objectives	To conduct research in broad areas of unmanned air, under water vehicles, and active magnetic bearing and active vibration control.
Courses taught	Element of vibrations and feedback control, Theory of vibrations, Applied System dynamics andcontrols, Parameter Estimation
Software available if applicable	Matlab/Simulink, ladder logic for PLC, Mission planner, Simscape, Solidworks, Creo.
Major Equipment/Apparatus	Servo motor module, aero-pendulum, mass cart system, inverted pendulum, quadcopter, base excitation system, rotating machines, 1-DoF electro-magnetic actuated cantilever beam, One degree of freedom spring mass system and cantilever beam, 2-DoF aircraft system, liquid level system, underwater vehicles, DAQ cards, oscilloscopes, power supplies, micro-controllers, variety of sensors and soldering facility.
Safety regulations	As per environment, health and safety rules of FME

Lab 6:

Laboratory Title	**Mechatronics Design Lab (MDL)**
Location and area	Ground floor, Rm# G25
Objectives	To conduct independent research in design and development of mechatronics system as well as an undergraduate teaching lab.

Courses taught	Robotics, Electrical Machines and Drives, Circuit and Electronics Devices
Software available if applicable	Ansys, Lab view, Matlab/Simulink and Creo
Major Equipment/Apparatus	5-DOF Robotic arm, 4-Dof Dobot Magician Robotic Arm, Mecanum Wheel based mobile Robotplatform
Safety regulations	As per environment health and safety rules of FME

Lab 7:

Laboratory Title	**Energy and Environment Research Lab**
Location and area	**2nd Floor**
Objectives	Research and development of Energy and Environmental systems
Courses taught	Engineering thermodynamics I and II, Energy Conservation and Management, Solar Energy Utilization, Advanced thermodynamics, Advanced solar thermal engineering
Software available if applicable	COMSOL Multiphysics, ASPEN Plus
Major Equipment/Apparatus	Gravitational Water Vortex Turbine, Gravitational Water vortex heat exchanger, Solar Adsorption/Absorption Bed, Pyranometer
Safety regulations	As per environment health and safety rules of FME

Labs 8 & 9:

Laboratory Title	**CNC Industrial and CNC Training Lab**
Location and area	Ground floor
Objectives	• Provide opportunity to research students to develop new manufacturing processes, and work on science of advanced manufacturing processes and processes design & optimization • Provide a platform to research students to work on design and construction of machine tools and IOT • Facilitate graduate and undergraduate students in respect of producing necessary tooling/equipment
Courses taught	Research on manufacturing processes, systems, machine tools, algorithmic, IOT, Production Engineering, Advanced CAD/CAM, metal forming mechanics
Software available if applicable	CNC machine soft wares, Pro-Engineer
Major Equipment/Apparatus	Lathes, Milling, wire-cut, 3D printer etc.
Safety regulations	As per environment health and safety rules of FME

Lab 10:

Laboratory Title	**Natural Fluids Refrigeration Center (NFRC)**
Location and area	NFRC, ground floor

Objectives	Experimental facility to do research on refrigeration problems using natural refrigerants.
Courses taught	Heat Transfer, Thermodynamics, Refrigeration
Software available if applicable	Matlab
Major Equipment/Apparatus	Ammonia Refrigeration cycle
Safety regulations	As per Environment, Health, and Safety rules of FME

Lab 11:

Laboratory Title	**Sub sonic wind tunnel Lab**
Location and area	Sub Sonic Wind Tunnel Lab, 2nd floor
Objectives	To study aerodynamics characteristics at subsonic level.
Courses taught	Advanced convection heat transfer, Advanced Thermodynamics, Boiling and condensation heattransfer, Industrial refrigeration
Software available if applicable	Data analysis software
Major Equipment/Apparatus	All aerodynamic related experiments in the sub-sonic range.
Safety regulations	As per Environment, Health, and Safety rules of FME

Lab 12:

Laboratory Title	**Solid Mechanics Lab**
Location and area	2nd floor
Objectives	To perform experiments related to mechanics of materials, stress- strain analysis etc.
Courses taught	Advanced Stress analysis, theory of shell and plates.
Software if applicable	ANSYS
Major Equipment	Gyroscope, drum brake and disc brake, clutch friction and belt friction, the plint-pack universal mechanism kit, residual strain measurement apparatus
Safety regulations	As per Environment, Health, and Safety rules of FME

Lab 13:

Laboratory Title	**Mechanical Workshop**
Location and area	Mechanical Workshop, Basement.
Objectives	To operate conventional machines for manufacturing.
Courses taught	Nill
Software available if applicable	None
Major Equipment/Apparatus	lathe, milling, shaper and drilling machines, sheet cutting, grinding, gas welding, electric welding, fitting shop, jig boring, wood cutting router
Safety regulations	As per Health and Safety (EHS) rules of FME

Lab 14:

Laboratory Title	Advanced Welding Laboratory
Location and area	G-23, Department of Materials Engineering
Objectives	Experimentation on different welding types
Courses taught	Joining of Advanced Materials
Software available if applicable	None
Major Equipment/Apparatus	MIG and TIG automatic and semi-automatic welding machines, Welding test rig, Instrumentation, laser welding machine
Safety regulations	As per Health and Safety rules of FME

Lab 15:

Laboratory Title	**Experimental Stress Analysis lab**
Location and area	Solid Mechanics lab, Faculty of Mechanical Engineering
Objectives	To study Structural mechanics and experimental stress analysis applications
Courses taught	Experimental Stress Analysis
Software available if applicable	ANSYS, Pro-E
Major Equipment/Apparatus	Imaging systems, transducers, Thermal Imaging Camera, thermocouples, pressure sensors, strain gauges, data loggers and other related instruments, hole drill strain measurement setup
Safety regulations	As per Health and Safety rules of FME

Lab 16:

Laboratory Title	**Composite Structures Lab**
Location and area	Machine Workshop, Faculty of Mechanical Engineering
Objectives	Study the mechanical behavior of composite materials
Courses taught	Mechanics of laminated composites, Tribology
Software available if applicable	
Major Equipment/Apparatus	Hand lay up of composites, resin infusion, vacuum assisted resin transfer molding, vacuum pump.
Safety regulations	As per Health and Safety rules of FME

Lab 17:

Laboratory Title	Electrical Machines and Drives Lab
Location and area	1ST floor, F09
Objectives	To conduct independent research in design and development of mechatronics system as well as an undergraduate teaching lab.
Courses taught	Electrical Machines and Drives, Circuit and Electronics Devices, AI in Design and Manufacturing, Mechatronic system design
Software available if applicable	Arduino, Proteus, Matlab
Major Equipment/Apparatus	Stepper Motor Apparatus, Dc Motor Apparatus, BLDC Motor Apparatus, Transformer Apparatus, Power supplies.
Safety regulations	As per Environment , Health and safety rules of FME

Lab 18:

Laboratory Title	Printed Electronics Research Lab
Location and area	Ground Floor
Objectives	Research and development of printed sensors and devices
Courses taught	Microelectromechanical systems and Additive Manufacturing
Software available if applicable	NI – Lab View
Major Equipment/Apparatus	Electrohydrodynamic jet printer, Direct Ink Write system, Ink preparation and modification, basic sensor electrical characterization
Safety regulations	As per Environment , Health and safety rules of FME

Summary of Computing Infrastructure Facilities

A well-established computing infrastructure is available at FME. Following licensed software is available for the training of students:

1. Creo
2. ANSYS (structural, thermal and CFD)
3. Solid Works
4. COMSOL Multiphyscis
5. MSC Adams
6. 3D Doctor
7. TRNSYS 17
8. Matlab /Simulink Software Suite

The students are encouraged/supported to employ above mentioned software in the course and research projects.

Research Groups

Design and Manufacturing

Main research areas in Design & Manufacturing include:
Advanced Manufacturing Systems
Additive Manufacturing
Welding and metal printing
Electrohydrodynamic inkjet printing
Composite structures
Sustainable manufacturing
Incremental sheet forming
High speed and deformation machining
Laser and Friction Stir processes

The research in the above-mentioned areas is supported by state-of-art equipment including Mirac PC lathe, Triac PC Milling Centre, Spectra Light Machining Centre, Laser scanner, 3D printer and Flexible Manufacturing System (FMS), Laser and MIG welding machines, Vacuum furnaces and Autoclave. Several characterization apparatuses such as SEM, AFM, XRD, Tensile test machine are also available to support the research in the faculty of materials science and engineering. The group also has collaboration with industry to solve real-life problems and to use their facilities if necessary.

This group has international linkages with Manchester Metropolitan University, Advanced Materials and Surface Engineering (AMSE) Research Centre, Cranfield University, UK, Beijing Institute of Technology, China, Institute of Mechanics, CAS, China, I-Form Advanced Manufacturing Research Centre Dublin city University, Nottingham Trent University and Tsinghua University China. Furthermore, this group has national linkages with SCME- NUST-Islamabad, CUST and EME-NUST-Islamabad, UET Lahore and COMSATS University.

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Thermo-Fluids

Main research areas in the thermo-fluids group include:
Biofuels and Microfluidics
Heat Transfer
Renewable Energy
Microelectromechanical Devices (MEMS)
Porous media
I.C. Engine performance and emissions
Natural Fluids Refrigeration
Desalination Technology
Thermal Energy Storage
Computational Fluid Dynamics (CFD)
Micro Hydro Power
Hemodynamics
Waste Heat Recovery Systems

The research in the aforementioned areas is being assisted by various facilities in the energy systems labs. It includes the Natural Fluids Refrigeration Centre (NFRC), in which a variety of condensation and evaporation heat transfer experiments can be conducted using natural refrigerants in different types of heat exchangers. Similarly, I. C. Engine test bench in the heat engine lab is capable of conducting advanced performance and emission characteristics analysis for SI and Diesel engines, using conventional and biofuels. The heat transfer lab is also assisting in research topics like solar energy utilization, phase change materials, micro channel heat sink design, and gravitational vortex flow heat exchanger design. The Biofuels and Microfluidics lab is focused on MEMS technology to develop cost effective diagnostic solutions for clinical, environmental, and food safety applications. The major equipment available for conducting research are state-of-the-art Engine Test Bed, Fuel Spray Analysis, 50W Laser Cutting and Engraving Machine, Ammonia Refrigeration Test bed, Subsonic and supersonic Wind Tunnel, and Thermal conductivity test bench.

This group has international linkages with University of Auburn, USA, KoC University, Turkey, Adana Alparsalan University, Turkey, Isotherm Inc, USA, Kyungpook National University, Korea, Teesside University UK, and Sejong University South Korea. Moreover, they are actively involved with many industries in Pakistan such as Hydrolink Engineering, Dawlance Pakistan, Colibrative Heavy Industries, Lahore, Pakengimed, Inter Market Knit (Pvt) Ltd, and Heavy Industries Taxila. At national level, they are engaged with NIBGE Faisalabad, COMSATS University Abbottabad Campus, UET Lahore, University of Peshawar, USPCASE Peshawar, UET RCET Campus, COMSATS Wah Campus.

Researchers

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System Dynamics and Control

Main research areas in System Dynamics and Control include:
Robotics Gripper/Hand Design
Soft Robotics

Electrical Machines and Drives
Path Planning and Grasping in a Cluttered Environment using Artificial Intelligence (AI)
AI applications in Structure Health Monitoring
System Modeling and Control of Dynamic Systems
The current research undertaken by the group is focused on the Robotics Systems, Design of Electrical Machines & Drives, Soft Robotics, and the Diagnosis & Prognosis of engineering assets. The team focuses on artificial intelligence-based structure health monitoring employing contact and non-contact type measurement technologies. Additionally, the team is actively engaged in research related to soft robotics, the design of robotics systems, path planning in dynamic environment, and implementing artificial intelligence for effective grasping in cluttered environments. Moreover, the team is focusing on design of electrical motor for direct drive EV applications and low RPM generators for multistage wind and water turbines.
This group has international linkages with the Bio-Robotics Institute of Scoula Superiore Sant' Anna Pisa, Italy. Moreover, the research group is collaborating in research with Hanyang and Dongguk Universities, South Korea. Additionally, the group actively participates in collaborative research initiatives with local industries and research centers, such as KSB pumps and the National Center for Composites. The labs in this area are well equipped with different robotics arms, contact/non-contact sensors, condition heath monitoring setups, electrical machine and drives setups and inhouse developed platform for robotics, electronics, and hydraulic & pneumatic feedback systems.

Researchers

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Computational Mechanics:

Main research areas in computational mechanics include:
Structural dynamics modeling
Multi-body dynamics
Material modelling
Molecular Dynamic Simulation (LAMMPS)
Simulation of fluid dynamics
Simulation of manufacturing processes and non-destructive testing (NDT)
Modeling and Simulation of Energy Systems
Fluid Structure Interaction

The computational mechanics research group is focused on the Structural & multi-body dynamic evaluation, Materials modelling, Design of nanomachinery through molecular dynamics simulation (LAMMPS), thermos-fluid systems, Manufacturing process and NDT simulation. The team is actively involved in rigorous computational analysis of thrust-absorber used in pumps, computational analysis of nano-robots, nano sensors under applied external field for microstructural evaluation and deformation behavior analysis. The team is also exploring the computational models of novel NPR structures for impact absorption applications.
This group has international linkages with the University of Bahrain, Hamad Bin Khalifa University, Qatar. Moreover, the research group is collaborating in research with Chinese academy of science and Beijing Institute of Technology, China. The group is working closely with the local company i.e. KSB pumps. The lab is well equipped with licensed modeling software's that includes MATLAB, Solid Works, ADAMS, and open sources packages likes LAMMPS.

Researchers

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FACULTY OF MATERIALS AND CHEMICAL ENGINEERING

DEPARTMENT OF METERIALS ENGINEERING

Dean

Fahd Nawaz Khan,
PhD (University of Northumbria, Newcastle, UK)

FACULTY

Department of Materials Science and Engineering

Fazal Ahmad Khalid, DPhil (University of Oxford, UK)
Fahd Nawaz Khan, PhD (University of Northumbria, Newcastle, UK)
Muhammad Imran Khan, PhD (University of Tsukuba, Japan)
M. Ramzan Abdul Karim, PhD (Politecnico di Torino, Italy)
Rashid Ali,PhD (Roma Tre University Rome, Italy)
Syed Zameer Abbas, PhD (GIK Institute of Engineering Sciences and Technology, Pakistan)
Shanza Rehan, PhD (University of Science and Technology, South Korea)
Mohsin Ali Marwat, PhD (Huazhong University of Science & Technology, China)
Dr. Hamza Mohsin PhD (Ecole Polytechnique, IP Paris, France)
Tauheed Shehbaz, PhD (GIK Institute)
Hafiz Muzammil Irshad, MS (KFUPM, KSA)
Engr. Umair Nasim

The Faculty of Materials and Chemical Engineering (FMCE) comprises of two departments:
1. Department of Materials Science and Engineering (DMSE)
2. Department of Chemical Engineering (DCME)

The FMCE employs internationally qualified faculty with diverse research expertise focusing on all classes and forms of materials (such as metals, ceramics, polymers, composites, nanostructures, and biomaterials), renewable energy (such as energy from solar and waste biomass) and chemical engineering areas such as process development and design engineering. State-of- the-art laboratories are available to provide hands on research skills to students in a conducive learning environment. The Faculty has a long record of academic achievements, which is manifested by commitment to excellence in teaching and high quality international publications in diverse fields of Materials and Chemical Engineering.

Faculty Mission

The faculty strives to train and educate students in the fields of Materials Science & Engineering and Chemical Engineering for their future role to contribute in academia, research, business and industry.

Degree Programs:

The faculty offers Master and PhD degree programs in advanced and technologically important areas of Materials as well as Chemical engineering. The program structure is as follows:

Course Work:

The courses offered enable the student to acquire in-depth understanding and development of innovative processing methods, mechanical and microalloying, ceramics and composites, polymers, magnetic and optical materials, superconductors, fiber technology, superalloys, shape memory alloys, metal oxide substrates, nanomaterials, biomaterials and for the evaluation of materials performance during fatigue, wear and corrosive failures.

MS Degree:

The courses offered by the faculty are categorized as core courses, faculty and inter-faculty electives. A MS student is required to complete 30 credit hours to be eligible for the award of MS degree. The student will take eight 03 credit hour courses, of which atleast, three should be the core courses and rest of them elective courses appropriate to the specific degree program in Materials or Chemical Engineering. On recommendations of the graduate advisor and approval by the dean of the faculty, a Master's student may register one 4xx course offered by the respective department that is inclusive of the total eight courses required. To be eligible for the award of MS degree, a student is also required to complete a six credit hour MS project/Thesis.

PhD Degree:

The courses to be taken by the student will be recommended and endorsed by the graduate advisor and Departmental Academic Committee respectively. A total of 36 credit hours are required to be completed. A PhD student is required to take eight courses of 500 or 600 level of three credit hour each to complete the course work. Out of six courses at least four must be from the list of courses of the respective department and the remaining can be registered from other faculties. A PhD student has to pass a comprehensive examination at the completion of his course work and is also required to complete a PhD dissertation of 18 credit hours to become eligible for a PhD degree.

Degree Plan:

The degree plan must be approved by the departmental academic committee in consultation with the graduate program advisor during the first semester and project advisor in subsequent semesters in the light of the departmental guidelines for graduate students.

Department of Materials Science and Engineering

The Department of Materials Science and Engineering is ranked among the top in Materials Engineering category. Since its birth, there have been rich contributions by local and foreign experts which played a key role in its evolution into one of rapidly emerging departments in the country. A number of students and researchers have benefitted from facilities and have established successful careers in research and academia.

Department Mission

The mission of the department of materials science and engineering is to develop and disseminate the understanding of structure, property, processing and performance of materials so that our graduates could lead and excel in academia, research, business and industry in ethical and professional manner.

Currently the department offers the following graduate degree programs.

1. Masters in Materials Engineering

2. Masters in Nanotechnology and Materials Engineering

3. PhD in Materials Engineering

Objectives of Materials Engineering Program

MS program in Materials Engineering is designed to achieve the following objectives:

1.To produce high caliber professional engineers who have thorough understanding of the field of Materials Engineering.
2.To produce skillful engineers having a diverse set of research skills and methodologies to work independently and collaboratively on research and applied projects in the field of Materials Engineering as well as in related disciplines in a professional and ethical manner.
3.To produce skilled manpower capable of solving real world/ complex engineering problems in society, industry and business innovatively.

Outcomes of Materials Engineering Program

After the completion of his/her studies, the MS graduate in Materials Engineering:

1.Will be able to identify, formulate and solve real-world engineering problems using knowledge acquired during the course of our graduate program in Materials Engineering.
2.Will have acquired the capacity to carry out research in the field of materials science as well as in multiple related disciplines professionally and ethically and, for this purpose, be able to use modern tools, techniques and strategies acquired during the course of his/her graduate study.
3.Will be motivated to pursue higher studies in institutes of higher learning both within the country and abroad.
4.Will have developed the ability to communicate effectively in written, oral, and graphical formats using latest available tools.

Objectives of MS in Nanotechnology and Materials Engineering Program

MS program in Nanotechnology and Materials Engineering is designed to achieve the following objectives:

1.To produce high caliber professional engineers who have thorough understanding of the field of Nanotechnology and Materials Engineering.
2.To produce skillful engineers having a diverse set of research skills and methodologies to work independently and collaboratively on research and applied projects in the field of Nanotechnology and Materials Engineering as well as in related disciplines in a professional and ethical manner.
3.To produce skilled manpower capable of solving real world/ complex engineering problems in society, industry and business innovatively.

Outcomes of MS Nanotechnology and Materials Engineering Program

After the completion of his/her studies, the MS graduate in Nanotechnology and Materials Engineering:

1.Will be able to identify, formulate and solve real-world engineering problems using knowledge acquired during the course of our graduate program in Nanotechnology and Materials Engineering.
2.Will have acquired the capacity to carry out research in the field of materials science as well as in multiple related disciplines professionally and ethically and, for this purpose, be able to use modern tools, techniques and strategies acquired during the course of his/her graduate study.
3.Will be motivated to pursue higher studies in institutes of higher learning both within the country and abroad.
4.Will have developed the ability to communicate effectively in written, oral, and graphical formats using latest available tools.

Objectives of PhD in Materials Engineering Program

PhD program in Materials Engineering is designed to achieve the following objectives.

1.To produce high caliber professionals who have in-depth knowledge of materials and competency in Materials Science and Engineering.
2.To produce scholar-engineers equipped with a diverse set of research skills and methodologies to carry out quality research independently or/and in a team in the field of Materials Engineering as well as in related disciplines in a professional and ethical manner.
3.To produce skillful manpower capable of solving innovatively complex engineering problems in society, industry and business outside the ivory tower in the real world.

Outcomes of PhD Materials Engineering Program

1.Will be able to identify, formulate and design strategies to solve real-world engineering problems using knowledge, skills, and values acquired during the course of our post graduate program in Materials Engineering.
2.Will have sound theoretical understanding to explain the behavior of materials under various circumstances.
3.Will have acquired the capacity to carry out research in materials science as well as in related disciplines professionally and ethically and be able to use modern tools, techniques and strategies acquired during the course of study in our post graduate program.
4.Will have developed the ability to communicate effectively in written, oral, and graphical formats using latest available tools.

Thrust Areas:

The Graduate Programs offer to pursue research in the following areas:

1.Phase Transformations in Materials
2.Advanced Processing and Characterization of Materials
3.Nanomaterials and Nanotechnology
4.Composite Materials and Ceramics
5.Surface engineering and Coating Technology
6.Corrosion and Oxidation
7.Biomaterials
8.Superalloys and High Temperature Materials
9.Energy Materials
10.Bulk Metallic Glasses
11.High Entropy Alloys
12.Failure Analysis

List of Courses for MS Materials Engineering Program

(A) Core Requirement (09 CH)

Course Code	Course Title
MM521	Mechanical Behavior of Materials
MM531	Phase Transformations in Materials
MM593/ NM593	Advanced Materials Characterization Techniques

(B) Program Technical Electives (06 CH)

Course Code	Course Title
MM511	Advanced Thermodynamics of Materials
MM523	Materials Selection & Failure Analysis
MM524	Metal Forming
MM532	Thermomechanical Processing
MM534	Advanced Manufacturing Systems
MM535	Advanced Joining Techniques
MM541	Process Metallurgy & Extraction
MM544	Modern Steels and Processes

(C) Common Technical Electives (03/06 CH)

Course Code	Course Title
NM536	Nanomaterials
MM545	Advanced Biomaterials
MM561	Carbon Materials
NM562	Carbon Nanomaterials and Fabrication
NM573	Nanomaterials and Computer Aided Nano-design
MM572	Engineering Design
MM551	Corrosion Monitoring and Prevention
MM553	Advanced Surface Science
MM556	Thin Film and Tribology
MM564	Polymer Science and Engineering
MM565	Ceramics Engineering
MM566	Electronic & Magnetic Devices
MM567	Advanced Composite Materials
MM568	Advanced and Nanostructured Materials
MM569	Advanced Functional Materials
MM592	X-Ray Diffraction and Texture Analysis

(D) Interfaculty Electives (03 CH)

Course Code	Course Title
EN571	Energy Materials
EN573	Hydrogen Storage Materials
EN574	Nanotechnology in Energy
EN581	Solar and Fuel Cells Technology
EM523	Marketing Management
EM524	Entrepreneurship
EM525	Business Plan and Venture Creation
EN521/MM581/ME597	Industrial Safety
ES514	Thin Films
ES515	Two-Dimensional Materials and Devices
ES531	Computational Methods for Engineers
ES562	Organic Solar Cells: Materials and Device Physics
ES563	Laser Materials Processing
CSE574/ME515	Finite Element Methods
ME514	Engineering plasticity
ME516	Applied Finite Element Analysis
ME555	Joining of Advanced Materials
ME582	Product Design
ME589	Modelling, Simulation and Visualization
MM582/ME598	Industrial Management
MM573/EN571	Materials for Energy Applications

*The student can opt a suitable interfaculty course (other than the ones mentioned above) in consultation with his research and graduate program advisors.

(E) MS Project/Thesis (06 CH)

Course Code	Course Title
MM599	MS Project/Thesis

(F) Total Credit Requirements (30 CH)

For the award of MS degree in Materials Engineering, a student must complete 30 credit hours.

List of Courses for MS Nanotechnology and Materials Engineering Program

(A) Core Requirement (09 CH)

Course Code	Course Title
NM536	Nanomaterials
NM537	Nanostructured Devices
NM593/ MM593	Advanced Characterization Techniques

(B) Program Technical Electives (06 CH)

Course Code	Course Title
NM536	Nano Engineering and Smart Materials
NM556	Thin Films and Tribology
NM562	Carbon Nanomaterials and Fabrication
MM568	Advanced and Nanostructured Materials
NM573	Nanomaterials and Computer Aided Nanodesign

(C) Common Technical Electives (03/06 CH)

As in Materials Engineering Program

(D) Interfaculty Electives (03 CH)

As in Materials Engineering Program

(E) Graduate Thesis (06 CH)

Course Code	Course Title
NM599	MS Thesis

PhD in Materials Engineering Program

Course requirement is eight 500 and 600 level courses from core courses, program technical electives or interfaculty technical electives. Completion of twelve credit hour PhD dissertation is also required for fulfilment of the degree requirements.

List of 600-Level Courses for PhD Materials Engineering Program

Course Code	Course Title
NM622	Theory of Dislocations
NM633	Microstructural Design and Control
MM635	Advanced Welding and Joining Processes

MM671	Computational Methods in Materials Science
MM673	Advanced Coatings
NM675	Energy Conversion and Storage Materials
MM691	Electron Microscopy

Course Description:

MM511 Advanced Thermodynamics of Materials (3-0-3):
Review of fundamentals of classical thermo-dynamics, Euler equation and Auxiliary functions, phase equilibria, chemical equilibria and condensed phase, Phase equilibria in single and multiphase component systems, Thermodynamics of phase transformations – first and second order transformations, Statistical thermodynamics, Special topics including: Thermodynamics of surface behavior, Thermodynamics of deformation and fracture, Thermodynamics of superconductivity and introduction to non-equilibrium thermodynamics,.

MM521 Mechanical Behaviour of Materials (3-0-3)
Mechanics of deformation, Elasticity, Plasticity, theories of plasticity, Deformation of single and polycrystal, Dislocation effects and geometry of deformation, Strengthening mechanisms, Creep and Fatigue of Materials, Deformation of composites, Fractography, Fracture mechanics, High temperature fracture, Embrittlement and radiation damage.

MM523 Materials Selection and Failure Analysis (3-0-3):
Types of failure according to UNI 8000, causes of failure, in service failure modes, techniques and procedures for failure analysis, maintenance, monitoring and lifetime predictions, tools of failure analysis, manufacturing processes and mechanical behavior of materials including fracture, fatigue, creep, corrosion, wear, environmental effects, weldment failure. Failure of polymers, ceramics, coatings and composites. Failure prevention. Methodologies of materials and process selection in structural and functional design (qualitatively and quantitatively), databases and materials information sources, materials selection charts.

Mm524 Metal Forming (3-0-3):
Stress and strain, macroscopic plasticity and yield criteria, work hardening, plastic instability, strain rate and temperature dependence of flow stress, Ideal work, friction, redundant work, and mechanical efficiency, slab analysis, upper-bound analysis, Slip-line field theory, Deformation zone geometry, formability, bending, plastic anisotropy, complex stamping and sheet metal.

MM531 Phase Transformations in Materials (3-0-3):
Equilibrium transformations; first order and second order transformations, Transformations in complex structures, diffusional and diffusionless transformations, thermodynamic and kinetic analysis, homogeneous and heterogenous nucleation, interfaces and microstructure, precipitation and its effect on properties, thermomechanical treatment, ultrafine grained alloys, Micro and Nano phases in alloys.

MM532 Thermomechanical Processing (3-0-3):
Steels: tempering, ageing, bainite and martensite, cementite and other carbides, Modern engineering steels such as: Microalloyed steels, ultra-low-carbon bainitic steels (ULCB), High strength low alloy steels, (HSLA), Thermomechanical processing, Design and processing concepts for new engineering steels.

MM534 Advanced Manufacturing Systems (3-0-3):
Manufacturing systems, agile and lean manufacturing, group technology, CIM, FMS, DFA, automation and industrial control technologies, sensors and other control systems, materials handling and identification processes, storage and inventory, quality control systems, statistical process control, design and process planning, quality control.

MM535 Advanced Joining Technologies (3-0-3):
Mechanical fasteners and joint design, adhesives and adhesive bonding, fusion and non-fusion welding processes (double electrode arc welding, plasma, high energy beam, EGW, ESW, projection, thermite welding, explosion, ultrasonic, diffusion, FSW processes), brazing (diffusion, infrared and microwave) and soldering (reflow and wave processes), metallurgy of welding, brazing and soldering, chemical reactions in welding, residual stresses and distortion, welding defects, tests of weldability.

MM541 Process Metallurgy and Extraction (3-0-3):
Free energy of formation, free energy diagrams, synthesis and production methods, reaction in steelmaking, gas-solid reactions in calcination, roasting

and reduction, liquid-solid reactions in leaching, liquid-liquid reactions, slag-gas-liquid reactions, Slag structures, basicity of slags, mattes, dross, fire refining, distillation, halide and vacuum metallurgy.

MM543 Solidification Processing (3-0-3):
Heat flow, solidification of alloys; single phase and eutectic solidification, castings and ingots, fluid flow, nucleation and growth, modeling of solidification process, dendritic growth and constitutional supercooling, semi-solid casting, rheology and modern methods to cast products.

MM544 Modern Steels-and Processes (3-0-3):
Principles related to iron and steel making, new trends in iron and steel making, blast furnace operation and productivity, electric steel making operations and productivity, methods of enhancing productivity and efficiency, direct reduction processes, strip and twin-roll casting, interface reactions, segregation, solidification processes, thermomechanical treatments, alloy steels, stainless steels and structural steels.

MM545 Advanced Biomaterials (3-0-3):
Biomaterials free energy of formation, cell-material interaction and biocompatibility, synthesis of hydroxyapatite (HA), advanced alloys for hip joints, prostheses and implants, surface coatings, dental materials, bio-glasses and bone cements, nano biomaterials, advanced processing, modeling and design aspects, composite materials for biomedical applications.

MM551 Corrosion Monitoring and Prevention (3-0-3):
Overview of thermodynamics and kinetics principles of corrosion. Passivity and its kinetics. Corrosion in various medias such as liquids, atmosphere, soils, concrete, stress induced and high temperature corrosion. Synergistic effects of corrosion on erosion. Monitoring and measurement techniques; Electrochemical methods of corrosion evaluation (Potentiodynamic Polarization, Linear Polarization resistance, cyclic polarization, impedance spectroscopy, noise analysis etc.). Corrosion risk assessment, corrosion prevention strategies; Design considerations and selection of materials for corrosive environments, coatings and inhibitors, cathodic protection, pipeline and oil rig protection.

Mm553 Advanced Surface Science (3-0-3):
Surface energy, thermodynamics of surfaces, surface reconstruction models, surface tension, wetting, adsorption models and surface area analysis based on adsorption, surface interactions with ion beams, electron beams and radiations. surface charge layers, measurement of surface potential (zeta potential), surface analysis techniques.

MM562 Carbon Nanomaterials and Fabrication (3-0-3):
Review of modern carbon nanomaterials, fullerenes and their derivatives, C60 and other forms, foams and felts, nanoparticles, synthetic diamond and diamond-like coatings (DLCs), structure and properties, molecular and crystal structures, chemistry of carbon nanotubes, Graphene, nanobelts, graphite whiskers, cones and polyhedral crystals, nanocrystalline diamond, carbide derived carbon, polymeric nanocomposites, nanotextured carbon for energy storage.

MM564 Polymer Science and Engineering (3-0-3):
Introduction to the molecular, morphological, mechanical and other properties of conventional and engineering polymers. Synthesis of polymers, configuration of polymer chains, thermodynamics and phase equilibria in polymer systems, viscoelasticity and rubber elasticity, processing of polymers, deformation and toughening mechanisms in polymers.

MM566 Electronic and Magnetic Devices (3-0-3):
Review of materials used in electronic applications, materials for semiconductor devices and VLSI. Thin film technology, metallization, packaging, opto-electronic devices and solar cells. Microelectronics - semiconductor technology, quantum electronics, superconducting materials, electronic materials for transducers, sensors and actuators. Electronic materials for radiation detection. Classification of magnetic materials, theory of magnetism, methods of observations of magnetic domains, magnetic anisotropy, magnetostriction, metallic and ceramic magnets, spintronic devices, transformer cores, magnetic recordings, magnetic storage devices. Permanent magnetic motors.

MM 567 Advanced Composite Materials (3-0-3)
Classification of Composites, reinforcements and the reinforcement-matrix interface, PMCs, MMCs, CMCs, mechanical properties and micromechanics of unidirectional composites and laminates, short fiber composites; fracture mechanics and toughening mechanisms, joining and testing (DT & NDT) of composites, processing methods of composites, processing, properties and applications of nano-composites.

MM 568 Advanced and Nanostructured Materials (3-0-3):
Review of fundamental properties of engineering and advanced materials, advanced and modern processing and surface treatments of materials and components, thermomechanical processes, production of fine metallic powders, mechanical alloying, high temperature materials for power plants and aerospace applications, automotive materials, shape memory alloys, bulk metallic glasses, high entropy alloys, biomaterials, superplasticity, Ti- and Al-based alloys, Nanostructured and smart materials, applications and processing of MMCs, CMCs, OMCs, nanocomposites and nanostructured materials

MM573/EN571 Materials for Energy Applications (3-0-3):
Review of engineering materials and their chemical, electrical, thermal, mechanical, magnetic and optical properties, Overview of renewable energy sources, advanced materials and their applications in energy sector, photovoltaic materials, role of materials design on the performance of photovoltaics, clean technology materials (fuel cell and thermoelectric materials), materials for energy efficient housing and buildings, high temperature functional materials and coatings, materials for nuclear power plants, reactor component materials, reactor fuel, nuclear radiation effects, photocatalytic materials.

MM593/NM593 Advanced Materials Characterization Techniques (3-0-3):
Review of materials characterization techniques, structural characterization techniques: optical microscopy techniques, electron microscopy techniques: SEM, ESEM, FEG-SEM and TEM, STEM., EPMA, atomic resolution and nano structural analysis techniques: STM and AFM, nano indentation. X-ray powder diffraction and residual stress, techniques. Thermal characterization techniques: DTA, DSC and dilatometry, spectroscopic techniques: XPS, AES, XRF, Raman, FTIR, NMR, SIMS. Chromatography: gas chromatography, mass chromatography, ion Chromatography.

MM565 Advanced Ceramics Engineering (3-0-3):
Structure of ceramics, characterization of ceramic powders and compacts. Sintering: thermodynamics and kinetics, advanced sintering techniques (SPS, HIP, SLS, microwave sintering, etc.). Rapid prototyping of ceramics, advanced ceramics related to energy generation and storage, advanced electro-ceramics, multi-layered ceramic capacitors, lead free piezoelectric ceramics, superconducting ceramics, functional ceramics, biocompatible and medical ceramics, bio-ceramics, advanced combustion engine parts, ceramic filters and membranes, advanced structural ceramics. Advanced glasses and glass ceramics. Weibull statistics, analysis of strength, fracture and toughening of ceramics.

MM622 Theory of Dislocations (3-0-3):
Review of crystal defects and dislocations, physical basis of dislocations and their elementary geometric properties, observations of dislocations, theory of straight and curved dislocations, dislocation interactions, effects of crystal structure on dislocations, slip systems of perfect dislocations, partial dislocations in FCC and other structures, dislocations in ceramics, dislocation motion and effects on strength and work hardening, diffusive glide and climb of dislocations, effect of temperature on dislocation movement.

MM633 Microstructural Design and Control (3-0-3):
Review of microstructure of metals and alloys, development of macro, micro, nano and atomic microstructure, effect of time and temperature on microstructure, effect of strain, recrystallization, theories of formation and rate of growth of nuclei, recrystallized grain size, grain growth, effect of impurities and inclusions, preferred orientations, secondary recrystallization, strain induced boundary migration, microstructure of ferrous and non-ferrous alloys. Microstructure in cyclic loading, high temperature applications. Environmental effects.

MM635 Advanced Welding and Joining Processes (3-0-3):
Mechanical joints and fasteners, fatigue resistance and combined loading, Friction stir welding and its variants, hybrid friction stir welding, microwave welding, ultrasonic and explosion welding, magnetic arc welding, high energy beam processes, hyperbaric welding, welding for cryogenic service, joining of metals to polymers and ceramics, joining of organic-matrix composites, joining of oxide dispersion strengthened materials, joining of intermetallics and ceramics, joining

of composites, functionally graded joints, joining in MEMs and NEMs, corrosion of weldments, joining of coated structures, joining of biomaterials, joining of high performance aerospace materials, joint evaluation and quality control.

MM 673 Advanced Coatings (3-0-3):
Classification of surface coatings, coatings for mechanical applications, corrosion resistant and thermal barrier coatings, chemical methods for surface coatings, plasma spraying, thin films, PVD, CVD, coating growth, nanostructured coatings and applications. Electrical discharges and plasmas (arc ignition, cathode spots, anode phenomena, coatings by vacuum arc deposition, arc sources and design, distributed and pulsed arc sources, filtered and steered arc, plasma coatings, APS, LPPS, amorphous coating, thermal barrier coatings, ion plating and ion beam assisted deposition, DLC, multilayered and composite coatings. Film characterization in terms of physical, mechanical, and chemical properties (residual film stress, thickness, density, porosity, microporosity and voids, optical properties.

MM/NM 675 Energy Conversion and Storage Materials (3-0-3):
Metal organic frameworks, nanoparticles, nanocomposites, nano-scaled electrocatalysts for lithium ion batteries, photovoltaics and fuel cells, carbon dioxide (CO_2) capture and hydrogen gas storage using tunable structured materials, electroactive materials, principles and application of electrochemical techniques for characterizing energy conversion and storage materials (e.g., voltammetry, potentiometry, conductometry, impedance spectroscopy), GCD analysis and scanning electrochemical microscopy.

MM 691 Electron Microscopy (3-0-3):
Theory of electron scattering from a crystalline material, X-ray microanalysis in SEM/TEM, different contrast mechanisms in SEM and TEM, micro and nanostructure analysis using different types of electron microscopes; TEM, SEM, STEM, HREM. Basic theory of imaging of crystal defects and crystal lattices in TEM, convergent beam, weak beam and microanalysis of thin foils using TEM, crystal structure analysis using TEM, concepts of Kikuchi patterns and zone axes in TEM. Qualitative and quantitative microstructural characterization using the EBSD technique in SEM, theory for high resolution SEM, high resolution imaging in FESEM. Composition analysis using SEM and TEM. Theory for electron energy loss spectroscopy (EELS), imaging and specimen thickness measurements by EELS. Special modes of testing in SEM and TEM. Specimen preparation techniques for SEM, TEM, EELS etc.

NM536 Nanomaterials (3-0-3):
Review of nanomaterials, synthesis of nanomaterials (nanoparticles, nanorods, nanowires, nanotubes, nanosheets, etc.). Purification and functionalization of nano materials. Chemical/catalytic, optical, thermal, electrical, magnetic and mechanical properties of nanomaterials. Characterization tools of nanomaterials, applications of nanomaterials and technologies, nanotribology, nanomechanics and fracture of nanocrystalline materials, ultrathin films, nanocomposites, environmental hazards, safety and handling of nanomaterials.

NM537 Nanostructured Devices (3-0-3):
Brief review of nanomaterials, nanostructured and nanoscale devices, Fabrication of nanostructures and devices; Single crystal growth, Nanolithography, Clusters, nanocrystals and Nanotube growth, 3D printing of nanomaterials, nano-electronic devices, Nanoelectromechanical systems (NEMS), Nanoscale sensors and detectors, Nanostructured devices for biomedical applications (tissue engineering), Nanoparticle-biomaterial hybrid systems for sensing applications, Nanostructured devices for thermoelectric applications, nanostructured energy devices, clean room technology.

NM556 Thin Films and tribology (3-0-3):
Thin Films growth techniques, PVD, CVD, MBE, magnetron processes, diamond like coatings (DLC), tribological and hard coatings for tools and engineering applications, functional coatings for electronic and magnetic materials applications, evaporation and sputtering techniques, atomic layer deposition, advanced surface characterization techniques, hard coatings and surfaces, friction and wear behavior of coatings, contact surface and interface properties, lubricants, modelling of wear behavior, rolling, nanotribology, abrasion, plastic deformation, contact fatigue.

NM/MM671 Computational Methods in Materials Science (3-0-3):
Computational modeling and its applications in thermal, structural and coupled analysis, casting design, and microstructure-based modeling (OOF-open source), computer programs for computational analysis, generic steps of the Finite Element Method (FEM), direct stiffness method and potential energy approach, weighted residuals methods, use of ANSYS Multiphysics for problem solving, axisymmetric

elements and their use, practical consideration in modeling, results interpretation, plane stress and plane strain analysis, thermal and structural stress analysis using ANSYS Multiphysics, use of ANSYS for structural optimization under thermal-structural coupled analysis, modeling in thin film and hard coatings, casting design and thermal solidification analysis using Solidcast, computer vision (CV) for automation and image analysis.

Labs & Research Facilities

The Faculty of Materials and Chemical Engineering has a range of laboratories for both teaching and research. The laboratories have equipment for processing many types of materials. Labs also house various characterization and testing equipment. These modern test facilities are also available for testing and inspection of materials on a commercial basis. The following lists the laboratories currently present within the faculty along with a brief description of the major equipment available:

Scanning Electron Microscopy laboratory (SEM Lab)
The scanning electron microscopy laboratory provides high-tech materials characterization. The lab is mainly used for observation of surface topography and microstructural characterization of almost all kinds of engineering materials. It not only can reach magnifications greater than 100000x but also provides the facility of chemical composition analysis of alloys. Information related to surface morphology, coating defects, chemical composition, microstructure, and fractured surfaces can be obtained. Associated sample preparation equipment like sputter coater is also present.

X-ray Diffraction Laboratory (XRD Lab)
The main equipment in the lab is X-ray Diffractometer. This lab is extensively used by the students of FMCE as well as other departments for their technical and research projects. The equipment is mainly used for the identification of crystal structures and phases, residual stress analysis and analysis of thin films. Latest software is available for the analysis of the results with a large database for sample identification and comparison.

Nano- and Biomaterials Laboratory
Research facilities for sol-gel synthesis, hydrothermal synthesis of nanomaterials, thin films development by spin-coating, calcination and thermal processing, bio- and composite materials development and in-vitro studies.

Metallography Laboratory
Optical Microscopy Laboratory contains the sample preparation facilities i.e., cutting, grinding, polishing, chemical and electrochemical etching. The lab is also equipped with optical microscopes for microstructural examination of metals, alloys, ceramic, polymer, and composite materials; Nomarski interference contrast; photomicrographic printing, video display of microstructures and microhardness testing. Facilities for computer-based image analysis are also available.

Corrosion Laboratory
Corrosion laboratory is equipped with electrochemical test cells with various accessories, computerized electrochemical measuring system, Potentiostats, sweep generators, Zero resistance ammeters, Rotating disk electrode equipment which allows study of corrosion behaviour under flowing conditions, facilities to perform corrosion studies in environments like H_2S, CO_2, CH_4 and various acidic and alkaline media. The lab is also equipped with GAMRY setup for advanced corrosion analysis.

Thin Films laboratory
Thin Film laboratory has the facility of thermal evaporation and magnetron sputtering to deposit thin films of metals, alloys and other materials on various substrates.

Alloy Making Laboratory
Alloy Making Laboratory contains a table-top controlled atmosphere arc melting furnace for making alloys of upto 20 gms. The alloys are mainly used for research purposes.

Mechanical Testing Laboratory
Mechanical Testing Laboratories have got the facilities to do almost all the conventional mechanical testing facilities i.e., Hardness testing (Rockwell, Brinell, Vickers and Universal portable tester for plastics) 5kN and 30kN universal testing machines (for tensile, compression and bend tests) 100kN universal testing machine (including creep and fatigue testing in the range -180 to 450 ° C) Izod and Charpy impact testing.

Heat Treatment Laboratory
Heat Treatment laboratory has various equipment used in heat treatment of materials like Box and tube type electrical furnaces (up to 1600 ° C). Vacuum and controlled atmosphere furnaces, Jominy end quench test apparatus (for hardenability experiments). Salt bath furnace and quenching facilities.

Materials Processing laboratory
The materials processing laboratory mainly contain the facilities to process the metallic and powdered materials i.e., lab scale rolling mill, hydraulic press and compaction dies.

Workshop
Workshop facilities are mainly used for sample preparation testing, student projects and general maintenance. The processes available are cutting, shaping, milling and drilling of samples. It also houses equipment used for welding and joining of materials. Workshop has also got a lathe machine, electric arc and gas welding equipment, brazing, soldering and other joining facilities.

Melting & Casting Laboratory
Melting & Casting Laboratory contains facilities of conventional metal casting. These include induction melting furnace, sand testing equipment (tensile, compression, shear, permeability, sieve analysis. Mold preparation, Sand Mueller, Molding processes (sand, shell, investment, and sodium silicate/CO2 molding processes), and centrifugal casting. Facilities for squeeze and centrifugal casting are also available.

Polymer Laboratory
Inter-departmental facilities are available for the spectroscopy, thermal analysis and mechanical testing of polymers and polymer composites. Processing facilities (injection moulding machine) is available to study and correlate the composition and process parameters with the mechanical properties of polymers and particulate composites.

Atomic Force Microscopy (AFM) and Nanoindentation Laboratory
The lab houses Atomic Force Microscope (AFM) and Nanoindenter for materials characterization, especially at the nanoscale. These advanced characterization techniques are capable of high-level topographical imaging, magnetic characterization, nanoindentation, etc. These facilities are used both for experiments and research.

Thermal Analysis Laboratory
The laboratory houses simultaneous thermal analyzer (STA) for determining the transition temperatures and thermal stability of various materials. It also houses thermomechanical analyzer (TMA) for determining various mechanical properties of material at different temperatures using a maximum load of 2 N.

Research Groups

Research Groups, Industrial and International Linkages at DCvE
The Research Group for the Department of Civil Engineering at GIK Institute proudly presents its diverse areas of expertise and international collaborations. Comprising three key research areas, we engage in pioneering work, collaborate with global partners, and contribute to cutting-edge advancements in the field of civil engineering.

Research Group: Natural Hazards Assessment and Risk Mitigation
This field is critical in addressing the escalating threat of natural disasters, as it helps identify risks and develop strategies to safeguard lives and infrastructure. Through international and industrial collaborations, our research group plays a vital role in enhancing disaster resilience and ensuring the safety of communities.
Team Leader
Dr. Mehtab Alam
Team Members
Dr. Hafiz Ahmed Waqas
Dr. Muhammad Waseem
Research Labs
Geotechnical Lab
Hydraulics and Hydrology Lab
Computing and Simulation Lab
International Collaboration
Institute of Mountain Hazards and Environment, China
China Pakistan Joint Research Center for Earth Science, Islamabad

Industrial Collaboration
Galiyat Development Authority
Research Group: Smart Materials and Design
Smart Materials, led by Prof. Dr. Muhammad Ashraf Tanoli, represents a frontier in civil engineering, revolutionizing construction through innovative materials and techniques. Collaborations with prestigious institutions and industrial partners enable GIK to drive advancements in digital construction covering sustainability, and performance of structures.
Team Leader
Prof. Dr. Muhammad Ashraf Tanoli
Team Members
Dr. Rao Arslan Khushnood
Dr. Hafiz Ahmed Waqas
Research Labs
Concrete Lab
Computing and Simulation Lab
International Collaboration
Shanghai Jiao Tong University, China

University of Illinois Urbana-Champaign, USA
Industrial Collaboration
WAPDA
Creative Engineering Consultant
Research Group: Sustainable Infrastructure Management and Automation
Led by our dedicated team, our research group specializes in the application of disruptive technologies to solve issues of construction and mobility sector, driving advancements towards smart cities and sustainable society. Through international collaborations and participation in key conferences, we are at the forefront of shaping the future of construction technology and management.
Team Leader
Dr. Shiraz Ahmed
Team Members
Dr. Numan Khan
Research Labs
Autocon Lab
Computer and Simulation Lab
International Collaboration
Collaboration with Chung-Ang University, Seoul, South Korea.
School of Surveying and Built Environment (SBE), University of Southern Queensland
Industrial Collaboration
J7 Group of Companies
Creative Engineering Consultant

DEPARTMENT OF CHEMICAL ENGINEERING

Dean

Prof. Dr. Javaid Rabbani Khan,
PhD (University of New Castle upon Tyne, UK)

FACULTY

Department of Materials Science and Engineering

Sajjad Hussain, PhD (University of Sao Paulo, Brazil),
Post-Doctorate (State University of Sao Paulo, Brazil).
Muhammad Shozab Mehdi, PhD Chemical Engineering (PIEAS, Pakistan)
Khurram Imran Khan, PhD Chemical Engineering (Politecnico di Torino, Italy)
Muhammad Usman Farooq, PhD Chemical Engineering, University of Waterloo, Waterloo ON Canada).
Hammad Amjad Khan, PhD Environmental Engineering (Hanyang University, South Korea)
Ramesha Tariq, MS Chemical Engineering (UET Lahore, Pakistan)
Abdul Wahab, MS Chemical Engineering (GIK Institute, Pakistan)
Nida Zafar, MS Chemical Engineering (NUST, Pakistan)

The dynamics of the research and process industry require professionals who can upgrade the present manufacturing processes, develop, and design alternative technologies. The graduate program in the chemical engineering department is specially designed to provide excellent opportunities to the students who will be seeking higher studies or carrying on their careers as professional engineers. The graduate program in chemical engineering consists of two degrees the Masters (MS) and Doctor of Philosophy (Ph.D.) degree programs

The strength of the graduate program in Chemical Engineering has the diversity that covers all major aspects of chemical engineering like designing, process dynamics & synthesizing energy sector, and materials production. The program is designed to provide in-depth knowledge of Chemical Engineering to enhance the analytical skills and research capabilities of the graduates. It is a unique opportunity to learn the latest and advanced technologies to resolve interdisciplinary complex engineering problems.

Graduates of the Chemical Engineering at GIK institute are expected to be able to use the techniques, skills, and modern engineering tools necessary for a promising professional to identify, formulate, innovative design, and solve bottlenecks utilizing critical-thinking and problem-solving abilities.

Department of Chemical Engineering (DChE) Mission

The mission of the department of chemical engineering is to develop and disseminate the understanding of designing and operations of chemical processes so that our graduates can excel in academia, research, business, and industry to contribute ethically for the humanistic development of the society.

Currently the department of Chemical Engineering offers the following graduate degree programs.

1. Masters in chemical engineering
2.PhD in Chemical Engineering

Program Objectives

Graduate Program in Chemical Engineering is design to achieve the following objectives:

1. To produce individuals who have a firm knowledge of the Chemical Engineering design.
2. To produce graduates equipped with research skills and methodologies in solving real world problems.
3. To produce graduates with capacity to pursue higher education and can serve in academia, research and development, industry, business, and other entrepreneurial activities.

Program Outcomes

After the completion of degree, the graduate from Chemical Engineering Department is expected to have the following traits:

1. Ability to apply their knowledge of mathematics, science, and engineering to solve problems related to the field of Chemical Engineering.
2. Ability to understand, formulate and solve real-world engineering problems.
3. Ability to realize new chemical processes and improve existing chemical industrial processes whenever situation demands such improvement.
4. Ability to research any topic of their choice and apply to it not only the most modern tools but also the latest techniques and technical skills acquired during the course of their study.
5. Ability to pursue higher studies in institutes of higher learning both within the country and abroad.
6. Ability to communicate effectively in written, oral and graphical formats by using latest tools available for such purposes.
7. Ability to work outside his field and be able to work in a multidisciplinary environment.

Thrust Areas:

The Graduate Programs offer to pursue research in the following areas:

1. Environment and Energy
2. Water and waste water treatment.
3. Reaction Kinetics and Catalysis
4. Membrane Technology
5. Modeling and Optimization

MS Course Work

To attain the MS degree in chemical engineering a graduate student has to complete 30 credit hours (8 courses generally 3 CHs each plus 6 CHs thesis). The coursework is distributed in three groups, the requisite research courses, the core, and the elective courses. The requisite research courses are mandatory with zero credit hours. From the core courses, a student has to take a minimum of 4 courses, while the remaining 4 courses can be selected based on the field of specialization on a selected research topic for MS thesis.

Ph.D. Course Work

The courses to be taken up by a student will be decided by the student's Ph.D. Guidance Committee and approved by the Dean of Graduate School. Out of six courses, at least four must be from the list of Graduate Chemical Engineering courses and the remainder from the other faculties of the institute.

II. REQUISITE RESEARCH COURSES

CH500	Research Methodology
XXXX	Seminar/Conference

II. CORE COURSES

CH501	Chemical Thermodynamics
CH502	Chemical Reaction Engineering
CH516/ES531	Computational Methods for Engineers
CH512	Experimental Design and Analysis
CH503	Transport Phenomena

III. ELECTIVE COURSES

(A) Design Engineering

CH521	Advanced Fluid Mechanics
CH522	Advanced Heat Transfer
CH523	Advanced Mass Transfer
CH517/ES533	Numerical Methods for Partial Differential Equations
CH531	Design of Heat Recovery Systems
CH533	Particle Dynamics
CH512	Experimental Design and Analysis
CH532	Project Management
CH529	Advance Wastewater Treatment Technologies

(B)Process Engineering

CH513	Process Design and Optimization
CH524	Biochemical Engineering
CH525/ME524	Computational Fluid Dynamics
CH526	Computer Aided Process Design
CH531	Design of Heat Recovery Systems
CH532	Project Management
CH534	Occupational Health and Safety in Process Industries

(C)Energy Engineering

CH527	Clean Coal Technology
CH514	Sustainable Energy Resources
CH528	Environmental Engineering
CH515/ME596	Energy Management & Auditing
CH535	Power Plant Engineering
CH532	Project Management
CH531	Design of Heat Recovery Systems

(D) Advanced Elective Courses

CH601	Computational Modelling of Reactors
CH611	Catalytic Reaction Engineering
CH621	Statistical Thermodynamics
CH631	Computer Aided Design in Chemical Engineering
CH641	Computational Multiphase Flows
CH651	Non-Newtonian Transport Phenomena

VI. Thesis/Project

CH599	**MS Thesis**
CH699	**Ph.D. Dissertation**

DESCRIPTION

The proposed course contents are recommended to be offered as part of three-credit-hour courses.

CH501 Chemical Thermodynamics (3-0-3)

Advanced topics in thermodynamics with emphasis on chemical and physical equilibria, and the estimation of thermodynamic properties. Methods of treating chemical and phase equilibria in multicomponent systems through the application of thermodynamics and molecular theory.

CH502 Chemical Reaction Engineering (3-0-3)

Review of fundamental principles; Order of reaction and rate equation; Theory of rate processes; Diffusion and types of reactors; Estimation of reaction rate parameters using empirical and quantum chemical methods, detailed chemical kinetic modeling. Design of chemical reactors for homogeneous and heterogeneous reactions; Analysis and comparison of the differences between batch and continuous reactor by using kinetics and mass, energy and momentum balances. Design of fixed-bed, fluidized-bed and industrial catalytic reactors.

CH503 Transport Phenomena (3-0-3)

Advanced treatment of conductive heat transfer and convective heat and mass transfer. Use of boundary conditions to obtain solutions in particular situations. Interfacial phenomena. Simultaneous heat and mass transfer. Turbulence and its measurements. Statistical approach to turbulent flow. Mathematical model of turbulence. Applications of continuity and Navier-Stokes equations of particular situations. Solutions of boundary layer equations. Application to equipment design. Transfer through membranes and transpiration cooling.

CH512 Experimental Design and Analysis (3-0-3)

Fundamentals of design of experiments; Interactions in processes; A systematic methodology for design of experiments; Single factor experiments; Analytical

comparisons among treatments and trend analysis; Two factor experiments; higher- order factorial experiments; Decreasing error variance; Other designs; Fitting regression models.

Ch513 Process Design and Optimization (3-0-3):
A coordinating course consisting of Chemical Engineering problems of considerable complexity which require for their solutions the application of thermodynamics, transport processes, reaction engineering. The selection of materials of construction. The organization for optimization. Optimization techniques. Function of a single variable. Analytical and numerical methods. Multivariable functions, analytical and numerical methods. Function of continuous variable, analytical and numerical methods. Optimization in practice.

CH514 Sustainable Energy Resources (3-0-3)
Sustainable Energy Resources Thermodynamics and heat transfer of sustainable energy sources for heating, power generation and transportation. Wind energy, solar thermal, photovoltaic, biomass, waste burning, and hydropower. Broad overview of the growing use of sustainable and renewable energy sources in the world economy with detailed analysis of specific applications.

CH515 Energy Management and Auditing (3-0-3)
Energy Auditing, Energy Bills. Energy management in thermal and electric utilities including HVAC, Energy Efficiency and Climate Change, Steam generation and distribution, Compressor and compressed air systems, Fans and Blowers, Pumps and pumping systems, Cooling towers, power generation, Lighting, Cogeneration, waste heat recovery, Energy Action Planning.

CH521 Advanced Fluid Mechanics (3-0-3)
Solutions of the Navier-Stokes equation; Percolation in porous media. Low Reynolds number flow. Creeping flow around a sphere. Laminar boundary layer. Free surface flows. Bubble dynamics at low, intermediate and large Reynold's number. Boundary conditions in the presence of surface active agents. Inter phase transport in isothermal systems. Fluid dynamics of two phase flow; purely viscous non-Newtonian constitutive equations. Fluidization.

CH522 Advanced Heat Transfer (3-0-3)
Optimal design of shell and tube heat exchangers; Pinch technology. Flow arrangements of increased heat recovery. Condensation of single vapors; Condensation of single and mixed vapors; Vaporizers, evaporators and reboilers. Extended surfaces heat transfer. Cooling towers. Furnace design and operation. Process design of equipment for heat transfer operation based on performance and economic optima.

CH523 Advanced Mass Transfer (3-0-3)
Uses and characteristics of separation processes; Simple equilibrium processes. Additional factors influencing product purities. Multi-stage separation processes. Patterns of change and computational approaches. Limiting flows and stage requirements. Empirical correlation, stage to stage methods. Successive approximation methods. Capacity and efficiency of contacting devices; Energy requirements of separation processes. Selection of separation processes. Optimal design and operation of separation processes.

CH524 Biochemical Engineering (3-0-3)
Characteristics of industrial micro-organism. Growth of micro-organism. Basic metabolic processes. Bio-degradation. Bio-mass productivity and activity. Aerobic and anaerobic processes; Nitrification and De-nitrification processes. Stirred tank bioreactor. Jet bioreactor. Reciprocating jet bioreactor. Hollow fiber bioreactor. Fluidized bed bioreactor. Application of various bio processes for the treatment of industrial wastes and production of chemicals. Theory of Bio-chemical processes involved in the production of food products, beverages, organic acids, industrial solvents, various pharmaceutical products and commercial enzymes.

CH525 Computational Fluid Dynamics (3-0-3)
General Differential Equations; Numerical solution of energy and Navier-Stokes Equations; Numerical schemes and algorithms; Methods of obtaining convergence; Transient analysis; finite difference and finite element methods applied to fluid mechanics; Matrix solving Techniques; Recent developments in CFD; Control Volume Formulation; Finite Volume Method. Development of computer programs for CFD problems.

CH526 Computer Aided Process Design (3-0-3)
Selection and design of chemical, biochemical or petrochemical processes, equipment and control systems, case studies. Comparison and optimization; Equipment evaluation and estimating procedures using computer methods. Process oriented Languages, data banks, decomposition methods related to process systems arrangement. Heuristic synthesis of equipment sequences. Application in chemical and petro-chemical processes.

CH527 Clean Coal Technology (3-0-3)
Origin, availability, types, characteristics, and analysis of coal; application of coal and related environmental impact; coal mining; coal cleaning technology; coal conversion to synthetic fuel; technology for power generation from coal; fuel gas cleaning technology.

CH 528 Environmental Engineering (3-0-3)
Combustion & air pollution (ozone, urban smog, acid rains), Industrial emissions (flu ash, flue gasses, particulate matters, smoke, soot), agro chemicals land & water pollution, transportation pollution, domestic & industrial waste water treatment (primary, secondary & tertiary), solid waste management (incinerators), role of catalysis in environmental engineering, nuclear waste management, energy conservation technologies, Heating, ventilation & air conditioning (HVAC) related environmental issues, Green technologies & renewable energies, environmental - 4 - impact analysis, policies and regulations, resource depletion and substitution, three Rs: reduce, reuse & recycle.

CH 529 Advance Wastewater Treatment Technologies (3-0-3)
Quality and quantity of water: Types of water and its chemical composition, Water Quality Parameters and its Measurement, Organoleptic parameters, Physico-chemical parameters, water Treatment, Wastewater Processing and Treatment: Preliminary Treatment, Primary Treatment, Environmental Chemical Analysis, Basic Principles of Wastewater Biological Treatment, Aerobic Biological Wastewater Treatment Process, Aerobic Biological Treatment Process, Biological Contact Oxidation Process, Aerobic Biological Fluidized Bed

CH531 Design of Heat Recovery Systems (3-0-3)
Introduction to heat integration, energy targeting and pinch analysis, heat exchanger network design for maximum heat recovery, heat exchanger design, utilities provision, capital and energy trade-offs, automated design of heat exchanger networks, retrofit of heat exchanger networks, heat engines, heat pumps, and refrigeration. Heat integration of reactors, separation processes. Data extraction.

CH532 Project Management (3-0-3)
Project identification and formulation. Project

selection models. Feasibility preparation including market evaluation, Demand forecasting. Site selection and survey. Plant capacity decisions. Project engineering including selection of technology. Industrial proprietary rights. Procurement operations; Contracts and contractors. Project implementation, PERT/CPM. Resource allocation; Cost estimates. Progress reporting. Industrial hazards and safety consideration; Quality Management in Projects. Project Audit; Use of computer software packages in project management.

CH533 Particle Dynamics (3-0-3)
Flow around particles. Drag force, Motion of particles and bubbles; Sedimentation. Settling. Fluidization. Centrifugation. Filtration. Gas cleaning. Theory of cyclones. Atomization. Power storage. Solid conveying. Aerodynamics; Instability of liquids and mechanics of drop formation. Agglomeration mechanics.

CH534 Occupational Health and Safety in Process Industries (3-0-3)
Introduction to occupational health and safety, basic concepts of health and safety in process industries. Hazards and types of hazards in chemical and process industries. Causes of accidents in industries, concept and principles of accident prevention in industries, risk analysis, safety performance measurement in industries, and strategies for control of occupational safety and health hazards in process industries.

CH535 Power Plant Engineering (3-0-3)
Power Plant systems, operation of conventional, renewable and nuclear power plants, Materials for Power plant, Gas & steam turbines and Generators, Gas Turbine Materials and Technology, Compressor, Turbine, Burners, Combustion Chambers, Combustion chemistry, Generators and auxiliary systems (Heat transfer & Gear assemblies), Power plants control and instrumentation, Water treatment for steam generation, cooling towers, control and safety of power plants, control and safety of power plants.

CH601 Computational Modeling of Reactors (3-0-3)
Computational flow modelling, mathematical modeling of flow processes, turbulent flow processes, multiphase flow processes, reactive flow processes, numerical solution of modelling equations, computational tools for flow processes. Application of reactors modeling: stirred reactors, bubble column reactor, fluidized bed reactors, fixed bed and other types of reactors.

CH611 Catalytic Reaction Engineering (3-0-3)
Fluid-fluid and fluid-solid heterogeneous reactions. Kinetics of surface reactions. Mass and heat transport phenomena. Catalyst effectiveness. Catalyst deactivation. Strategies for catalyst testing. Modern examples of heterogeneous reactions.

CH621 Statistical Thermodynamics (3-0-3)
Probability theory and statistical mathematics. Basics of quantum mechanics, quantum analysis of internal energy modes, The Spectroscopy of Diatomic Molecules, Interlude: From Particle to Assembly, Thermodynamic Properties of the Ideal Gas, Statistical Thermodynamics for Ideal Gas Mixtures, Concentration and Temperature Measurements, Elementary Kinetic Theory, Kinetics of Molecular Transport, The Canonical and Grand Canonical Ensembles, Applications of Ensemble Theory to Real Gases

CH631 Computer Aided Design in Chemical Engineering (3-0-3)
Computational Modelling: An Introduction Algebraic linear models Algebraic non-linear models advanced concepts in solving nonlinear models. Experimental design and parameter estimation. Dynamic systems. Distributed parameter systems. Optimization: Concept & Basics. Optimality Conditions and One Dimensional Unconstrained Optimization Multi-dimensional unconstrained optimization. Theory of constrained optimization. Linear Programming. Non-linear programming (NLP) with constraints. Mixed integer programming (MIP)

CH641 Computational Multiphase Flow (3-0-3)
Computational multiphase flow basic theory and research & design tools. Governing Equations and Boundary Conditions, solution methods for multiphase flows, Gas-Particle Flows, liquid-particle flows, gas-liquid flows, free surface flows, freezing/solidification, three phase flows, future trends in handling turbulent multi-phase flows.

CH651 Non-Newtonian Transport Phenomena (3-0-3)
Flow phenomena in polymeric fluids, mathematical preliminaries, Material functions for Polymer Liquids, Generalized non-Newtonian Fluids, Linear Viscoelasticity, Rheometry, Gels and Chemo-rheology of Reacting Systems, Suspensions and Multiphase Systems, Polymer Melts and Solutions

CH599 MS Thesis (6 CHs)
Description: As per GIK Institute Policy
CH699 Ph.D. Dissertation (18 CHs)
Description: As per GIK Institute Policy

Research Groups

1. Water Treatment and Modelling
Prof. Dr. Javaid Rabbani
Dr. Sajjad Hussain
Dr. Hammad Amjad
This research area focuses on developing innovative methods to purify and manage water resources. Researchers employ advanced chemical processes and modeling techniques to remove contaminants and optimize treatment systems. They address emerging challenges like pharmaceutical and microplastic removal, decentralized treatment, and eco-friendly methods. Their work is crucial for ensuring access to clean and safe water, protecting ecosystems, and supporting global water sustainability efforts.
Equipment:
Laboratory Ultra Water Purification System Beoco Pure Plus UV/UF Beoco, Germany.
UV-Visible spectrophotometer
Atomic Absorption Perkin Elmer USA
OZONE GENERATOR (SKYZONE®)

2. Catalysis
Dr. Khurram Imran Khan
Engr. Abdul Wahab
Engr. Ramesha Tariq
Catalysis is a fundamental area of chemical engineering research that explores the science and technology of catalysts. Catalysts are substances that enhance the speed and efficiency of chemical reactions without being consumed in the process. We study various aspects of catalysis, including catalyst design, synthesis, and application. They aim to develop catalysts that are both highly selective and efficient, enabling cleaner and more sustainable chemical processes. Catalysis research plays a pivotal role in diverse applications, from the production of fuels and chemicals to environmental remediation and pharmaceutical synthesis. It contributes to improving the overall efficiency and sustainability of chemical industries while reducing their environmental footprint.
Equipment:
Locally fabricated Photoreactor
Gas Chromatograph
Tube Furnace
Box / Muffle furnace
Vacuum Oven
Centrifugation up to 8000 rpm

3. Membrane Technology
Dr. Muhammad Usman Farooq
Dr. Muhammad Shozab Mehdi
Engr. Nida Zafar
Membrane technology in chemical engineering focuses on developing and optimizing selective barriers, or membranes, for separation processes. We are working on enhancing membrane materials and manufacturing techniques. These membranes find vital applications in desalination, wastewater treatment, and pharmaceutical purification, improving efficiency and sustainability in various industries. Membrane technology contributes to cleaner water production, resource recovery, and eco-friendly chemical processes, reducing energy consumption and environmental impact.
Equipment:
Four-Sided Wet Film Coating device or Film Applicator (50µm - 200µm)
Dead-end filtration cell and stirred cell fitted with nitrogen cylinder and regulators.
National Collaborations
Dr. Muhammad Faheem, University of Engineering and Technology (UET), Lahore.
Dr. Adnan Khan, University of Peshawar, Peshawar.
Dr. Muhammad Younas, UET Peshawar, Peshawar.
Dr. Humayoun, Islamia College Peshawar, Peshawar.
Dr. Muhammad Wajid, University of Hazara, Mansehra.
Dr. Muhammad Yaseen, University of Peshawar, Peshawar.
International Collaborations
Prof. Hyeok Choi, University of Texas, Arlington, USA.
Prof. Maria Valnice, Institute of Chemistry, State University of Sao Paulo, Brazil.
Prof. Artur de Jesus Motheo University of Sao Paulo, Brazil.
Prof. Eder Lima Universidade Federal do Rio Grande do Sul (UFRGS) Brazil.
Prof. Abdeltif Amrane University of Rennes, France.
Prof. Feryal Akbal Ondokuz Mayıs University, Turkey.
Dr. Muhammad Saeed Akhtar Yeungnam University, South Korea.
Industrial Collaborations
Engr. Nabeel, Dynea Pakistan Ltd. Gadoon Swabi.
Mr. Gohar Jamal, SAHARA Recyling Pvt Ltd. Lahore.
Khizar Iqbal, Attock Oil Refinery, Rawalpindi.

DEPARTMENT OF CIVIL ENGINEERING

Thrust Areas

Water Resources Engineering

Geotechnical Engineering

Structural Engineering

HoD

Prof. Dr. M. Ashraf Tanoli

PhD

FACULTY

Faculty

Rao Arslan Khushnood	PhD (Politecnico di Torino, Italy)
Khawar Rehman (Study Leave)	PhD (Hanyang University, Republic of Korea)
Shiraz Ahmed	PhD (University of Hasselt, Belgium)
Muhammad Waseem	PhD (University of Rostock, Germany)
Hafiz Ahmed Waqas	PhD (University of Tokyo, Japan)
Mehtab Alam	PhD (University of Chinese Academy of Sciences, China)
Numan Khan	PhD (CHUNG-ANG University, South Korea)

The department strives to produce competent professionals who have sound knowledge in the field of Civil engineering. We aim to produce graduates having enhanced creative thinking, problem solving skills and ability for lifelong learning in their professional careers, and to develop research programs to address the evolving needs of industry, academia, and society. The graduates of the Department of Civil Engineering shall play a productive role both in practical and research areas of computing. The department uses modern technologies to enhance the learning capabilities of the students and to provide them with a stimulating and challenging environment. Emphasis is placed on the practical applications of civil engineering to the needs of the global industry in general and the Pakistani industry. The faculty offers courses leading to Bachelor's (BS), Master's (MS) and Doctor of Philosophy (Ph.D.) degrees in Civil Engineering.

Introduction

Higher education (graduate degree) in Civil Engineering is paramount to open doors that are not otherwise accessible. These opportunities include research positions at corporations/laboratories and teaching/research positions in academia at the national and international levels. A career at this level enables one to achieve satisfaction through exploration of their own idea and creativity skills. Graduate degree in Civil Engineering allows one to expand their knowledge towards problem-solving, accepting new challenges, and playing important role in the development of humanity. It increases the employment opportunities and allows one to enter the Civil Engineering practice in specific areas of expertise.

Realizing the importance of graduate studies for addressing the design and construction issues, coping with new challenges of modern construction trends, and the need for continuing education and research in the current competitive environment, the GIK Institute, has decided to launch MS and PhD programs in Civil Engineering capitalizing upon the already well-established state-of-the-art infrastructure for undergraduate studies at the campus.

Towards this end, the GIK Institute has already taken important measures to launch graduate program. These measures include hiring of foreign-qualified PhD faculty (refer to Faculty Strength), upgrading of the existing lab infrastructure, enhancing the library collection of textbooks and scientific journals, and expanding the instructional and research space on campus.

Department Mission

The department aims to produce competent engineers who can work in the society, both as field professionals and academic researchers. The department also aspires to produce engineers who can integrate theories and practices of civil engineering while being exposed to contemporary issues in the industry.

The Graduate Program in Civil Engineering

The Department of Civil Engineering at GIK Institute, offers two graduate Programs:

- Master of Science in Civil Engineering

- Doctor of Philosophy Civil Engineering.

Course Work

MS Program: Requirement is minimum 24 credit hours of course work and 06 credit hours of thesis involving research work.

Core Courses	Area Electives	Other – Faculty Electives
2	Max. 5*	Max. 2*

PhD Program: Requirement is minimum 18 credit hours of course work beyond master's course work along with a dissertation of eighteen credit hours and at least two research oriented papers in international journals. The courses to be taken up by a student will be decided by the student's PhD Guidance Committee and approved by the Dean of Graduate School. Out of six courses, at least four must be from the list of DCvE courses and the remainder from other faculties.

List of Core Courses for MS Civil Engineering

Course Code	Course Title	Credit Hours
CV501/ME515	Finite Element Method	3(3,0)
CV502/ES531	Computational method for Engineers	3(3,0)
CV503/ES533	Numerical methods for partial differential equations	3(3,0)
CV504	Applied Statistics for Civil and Environmental Engineers	3(3,0)

List of Elective Courses for Water Resources Engineering- Stream

Course Code	Course Title
CV521	Open Channel Hydraulics
CV522	River Engineering
CV523	Sediment dynamics
CV524	Statistical Hydrology
CV525	Groundwater Engineering
CV526	Hydropower Engineering
CV527	Hydraulic Structure Design
CV621/ME521	Advanced Fluid Mechanics
CV622	Computational Hydraulics
CV623/ME524/CH525	Computational Fluid Dynamics
CV624	Catchment and River Hydrology
CV625	Coastal Engineering
CV626	Geophysical Fluid Dynamics
CV627	Disaster prevention Hydraulics
CV628	Hydrologic analysis
CV629	GIS for Water Resources
CV661	Advanced Environmental Impact Assessment
CV662	Integrated Water Resources Management
ME624	Turbulence

List of Elective Courses for Geotechnical Engineering- Stream

Course Code	Course Title	Credit Hours
CV531	Advanced Engineering Geology	3(3,0)
CV532	Advanced Soil Mechanics	3(3,0)
CV533	Geotechnical Tests and Investigations	3(3,0)
CV534	Advanced Foundation Engineering	3(3,0)
CV535	Ground Water in Geotechnical Engineering	3(3,0)
CV536	Dam Engineering	3(3,0)
CV537	Slope Stability	3(3,0)
CV538	Geo-environment Engineering	3(3,0)
CV539	Forensic Geotechnical Engineering	3(3,0)
CV631	Numerical Modeling of Porous Media	3(3,0)
CV632	Soil Dynamics	3(3,0)
CV633	Advanced Rock Mechanics	3(3,0)
CV634	Underground Excavation and Tunneling	3(3,0)
CV635	Geotechnical Earthquake Engineering	3(3,0)
CV636	Unsaturated Soil Mechanics	3(3,0)
CV637	Ground Improvement and Geosynthetics	3(3,0)
CV638	Geo-sensing & measurements	3(3,0)
CV639	Earthquake Seismology & Hazard	3(3,0)

List of Elective Courses for Structural Engineering- Stream

Course Code	Course Title	Credit Hours
CV511	Advanced Structural Analysis	3(3,0)
CV512	Advanced Structural Mechanics	3(3,0)
CV513	Advanced Concrete Technology	3(3,0)
CV514	Advanced Pre-Stressed Concrete	3(3,0)
CV515	Advanced Concrete Design	3(3,0)
CV516	Advanced Steel Structures	3(3,0)
CV517	Computer Aided Analysis and Design of Structures	3(3,0)
CV518	Design of Masonry Structures	3(3,0)
CV611	Dynamics of Structures	3(3,0)
CV612	Earthquake Engineering	3(3,0)
CV613	Structural Design Optimization	3(3,0)
CV614	Bridge Engineering	3(3,0)
CV615	Wind Engineering and Structures	3(3,0)
CV711	Modeling of Concrete Performance	3(3,0)
CV712	Nonlinear Analysis in Civil Engineering	3(3,0)
CV713	Special Topics in Structural Engineering	3(3,0)

Thesis/Project

CV599	MS Thesis
CV699	PhD Thesis

COURSE DESCRIPTION

CV501 Finite Element Method (3-0-3)

Application of FEM, the stiffness method and the plane truss, two-dimensional stress analysis by FEM, energy, Variational principles and Ritz technique, elements based on assumed displacement fields, The iso-parametric formulation, coordinate transformation, Topics in element formulation and use, Solids of revolution, Bending of flat plates, Three-dimensional stress analysis, General field problems, Sample computer code and other practical considerations

CV502/ES531 Computational method for Engineers (3-0-3)

Direct and indirect methods for linear equations, eigen value problems and eigen vectors, finite difference methods for boundary value problems and partial differential equations.

CV503/ES533 Numerical methods for partial differential equations (3-0-3)

Parabolic equations, explicit and implicit methods, consistency, stability and convergence, hyperbolic equations, method of characteristic and lines, finite difference methods, elliptic equations, finite difference replacements, finite element methods for elliptic problems.

CV504 Applied Statistics for Civil and Environmental Engineers (3-0-3)

Preliminary Data Analysis, Probability Concepts, Random Variables and Their Properties, Probability Distributions, Model Estimation and Testing, Methods of Regression and Multivariate Analysis, Frequency Analysis of Extreme Events, and Simulation Techniques for Design

CV521 Open Channel Hydraulics (3-0-3)

The conservation laws are revisited. Applications of the energy and momentum principles are discussed. Hydraulic behavior of open-channel flow can be very different under the subcritical and supercritical conditions. Flow resistance formulas in relation to the boundary layer theory, normal flow calculations for uniform, grass-lined, riprap, composite, and compound

channels. Water surface profile calculations for gradually-varied flow. Identification of the flow controls, predict the profile, and formulating a solution. Hydraulic design of different types of open channels. Unsteady flow.

CV522 River Engineering (3-0-3)

In this course, the advanced concepts of hydraulics based on engineering mathematics and fluid mechanics will be instructed. Main contents include river engineering, investigation of river, sediment transport, and turbulence in open channels. Also covers river science and river control, flood protection, introduction to the calculation bases, the influence of climatic changes. Besides the wide range of fields covered, key issues are discussed that are the topic of current political debate (currently: climate change and flood protection).

CV523 Sediment dynamics (3-0-3)

Students in this class acquire an in-depth knowledge of sediment transport and the morphodynamic development of channels. After completing this module, students should be capable of understanding the natural morphodynamics of rivers, the anthropogenic influence thereon, both today and in the future. Students also gain a broader knowledge of research methods: knowing the advantages and disadvantages of each method provides a basis for independent decision-making when solving practical problems.

CV524 Statistical Hydrology (3-0-3)

Statistical methods which are appropriate for analysis of water resources data. Common characteristics of water resources data. Selection of appropriate data analysis procedures. This course will enable the environmental and water resources scientist to robust and nonparametric statistics, and to exploratory data analysis.

CV525 Groundwater Engineering (3-0-3)

Students learn methods for determining the water demand and water management parameters using modelling methods. They also gain an overview of urban development and hydraulic engineering projects for influencing groundwater storage, for instance, in arid conditions.

CV526 Hydropower Engineering (3-0-3)

Introduction and importance of Hydropower development. Comparison of hydropower with other energy sources, stages. Main components of low, medium and high head power schemes. Selection criteria of a particular type of scheme and its approval

steps. Hydro-mechanical, electro-mechanical components and auxiliary equipment. Hydropower Project layout and sizing, alternative project layout. Detail of quantities and costs in different stages of Project development, estimation of quantities, cost, optimization and selection of the Plant size. Powerhouse, Power Canal, Intake Waterways, Pressure Relieving Structures and dewatering of Powerhouse Pit. Hydro-mechanical components: Turbine, Governor, Trash rack and Stop logs. Electro-mechanical components: Generator, step-up transformer, High voltage switch gear, low voltage switch gear, high voltage circuit breakers, MVILV installations, control and protection.

CV527 Hydraulic Structure Design (3-0-3)

Design of dams, barrages and weirs, design of components. Water management, Analysis and hydraulic design of irrigation structures (dams, barrages, canals, outlets, pumping stations etc.), highways structures (bridges, culverts, causeways etc.), river control structures and coastal structures (Jetty Wharves, lock gates etc.), Modeling and analysis of bridge scouring problems, Analysis and hydraulic of Water retaining structures (overhead water tanks, swimming pools, underground storage structures). Energy dissipation mechanism for hydraulic structures. Modern trends in the design, construction and monitoring of hydraulic structures.

CV661 Advanced Environmental Impact Assessment (3-0-3)

Framework of EIA, the EIA process and stages, examples of techniques used in impact assessment relating to topics including soils, Legal context for EIA, Global perspective, Quality assurance, Landscape and visual impact assessment, Ecology & biodiversity, Climate change adaptation & mitigation, economic impact assessment, the local government perspective.

CV662 Integrated Water Resources Management (3-0-3)

Natural surface and groundwater streams management, controlling and using water streams for society. This covers both ground and surface water, as well as rainfall and waste water. Water management also considers not just the quantity of water, but the quality of ground and surface water.

CV621/ME521 Advanced Fluid Mechanics (3-0-3)

Introduces the principles of fluid mechanics and is intended for graduate students of science and engineering. No previous knowledge of the subject is assumed. The class deals with basic concepts and definition for fluid mechanics, tensor algebra, flow kinematics, and governing equations for fluid flows. In addition, it discusses incompressible and inviscid flows and vorticity dynamics.

CV622 Computational Hydraulics (3-0-3)

The basics of computational hydraulics is introduced. Although the main method is the finite difference method, the finite volume method is also described. Three kinds of partial differential equations are tried to solve with proper techniques. The types of boundary conditions are taught in detail. Students acquire advanced knowledge of numerical methods for solving flow and transport processes in channels and in groundwater. A key aspect of the class is to teach students about modelling processes. Furthermore, students are encouraged to apply numerical methods independently using conventional numerical simulation software in the area of water resources managements.

CV623/ME524 Computational Fluid Dynamics

CFD is using computer to calculate internal or external flow of given configuration. Involves very strong nonlinearity and discontinuity in governing equations. To analyze fluid dynamics, it demands various mathematical or numerical approximations. To study fluid characteristics of the governing equations and appropriate numerical method. Particularly, governing equation is separated by elliptic, hyperbolic, parabolic and then, apply appropriate numerical method in this characteristic. The objective of the course is to enhance the ability to resolve the practical problem on one's own by combining theory and application problems.

CV624 Catchment and River Hydrology (3-0-3)

Hydrologic processes and measurements: rainfall, infiltration, and surface runoff. Hydrograph analysis and synthesis. Hydrologic and hydraulic flood routing. Probability in hydrology: data selection and frequency analysis. Hydrologic modeling. Drainage design: rainfall curves, flood peak estimation, highway drainage. Flood mitigation: detention ponds, channel improvements.

CV625 Coastal Engineering (3-0-3)

This class provides students with a numerical basis of coastal engineering. It highlights major differences to inland hydraulic engineering activities and, in doing so, builds on the technical background by covering important topics such as the linear wave theory, wave transformation, swell, tides and storm surges, planning and design of breakwaters, sea ports, maritime waterways and sea dikes

CV626 Geophysical Fluid Dynamics (3-0-3)

Principles governing air and water flows on large terrestrial scales. Physical principles are illustrated with the aid of the simplest existing models, and the computer methods are shown in juxtaposition with the equations to which they apply. It explores contemporary topics of climate dynamics and equatorial dynamics including the Greenhouse Effect, global warming, and the El Nino Southern Oscillation.

CV627 Disaster prevention Hydraulics (3-0-3)

Hazards and Disasters (Concepts), Hazard Dimensions Distributions, Patterns, Associated Processes & History of Hazards Research, Social & Economic Aspects of Natural and man-made Hazards, Individual and Community Adjustments: Perceptions, Attitudes and Behavior, Hazard and Disaster Investigation Hazard Vulnerability, Assessment & Mapping, Element at risk mapping Risk Management, Disaster Management Cycle, Pre-Disaster Phase (Prevention, Mitigation & Preparedness), Disaster Phase (Response), Post-Disaster Phase (Rehabilitation, Development), Damage assessment, loss analysis, Risk management in development planning. Disaster management policies and infrastructure at local and national level.

CV628 Hydrologic Analysis (3-0-3)

Time series analysis; descriptive techniques, stationary time series, time Plot, transformations, trend analysis, seasonal variation analysis, autocorrelation; time series models, stochastic and stationary processes, autocorrelation function; forecasting, univariate and multivariate procedures, comparative review of forecasting procedures; bivariate and multivariate modeling.

CV629 GIS for Water Resources (3-0-3)

Fundamentals of remote sensing and GIS techniques, platforms and Sensors, visual image analysis, digital image processing and image enhancement techniques. Introduction to spatial hydrology and catchment water balance determination. Brief history of remote sensing and GIS in water resources management. Remote sensing methods for estimating of precipitation and evapotranspiration. Remote sensing and GIS applications for flood plan management, river basin planning and management.

ME624 Turbulence (3-0-3)

Nature of turbulence, Turbulent transport of momentum and heat. Dynamics of turbulence. Examples of turbulence flows. Statistical description of turbulence. Spectral dynamics.

CV531 Advanced Engineering Geology (3-0-3)

Geology and Civil Engineering, Igneous rock, Surface processes, Sedimentary and Metamorphic rocks, Geological structures, Plate tectonics, Boundary Hazards, Weathering and Soil, Floods Plans and Alluviums, Ground Water, Site Investigation, Site Investigation Borehole, Geophysical Survey, Assessment of difficult ground, Rock Strength, Rock Mass Strength, Ground Subsidence, Subsidence on Clay, Subsidence over Lime Stone, Subsidence over Old Mines , Mining Subsidence, Slope Failures and Landslides, Water in Landslides, Soil Failures and Flow slides, Landslides Hazards, Slope Stabilizations, Rock Excavation, Tunnels in Rock, Stones & Aggregates.

CV532 Advanced Soil Mechanics (3-0-3)

Stress-strain soil, Mohr's circle of stress and strain increment, stress invariants, Isotropic / anisotropic moduli; Modeling of drained and undrained behavior, the role of elasticity in soil mechanics, Small strain elasticity theories, plasticity theory, Yield in sands and clays. Volume change and plastic hardening; critical state concept, behavior of normally/over-consolidated clays, and loose/dense sands, stress-dilatancy; Mohr-coulomb failure, Critical state line and undrained/drained strength, Peak and residual strengths, Stress paths and laboratory tests.

CV533 Geotechnical Tests and Investigations (3-0-3)

Experimental Soil Mechanics; Methods of soil exploration and their importance; Laboratory and In-situ Testing, their merits and demerits, Probing, test trenches and pits, auger boring, wash boring, rotary drilling and geophysical methods; Field Instrumentation, Types of soil samples, samplers and soil sampling; Field Investigation program; Risk in the contract process: tenders, specification, conditions of contract; How to set about designing an investigation; Identifying risks, choice of methods, constraints to design - access, cost and availability; Geotechnical investigation report and Geotechnical design report.

CV534 Advanced Foundation Engineering (3-0-3)

Investigation of subsurface condition; Principles of foundation engineering; Theories of bearing capacity and settlement; Stress distribution due to eccentric loading; Principles for the design of shallow foundation; Geotechnical design of shallow foundation; Geotechnical design of Retaining walls and abutments; Settlement analysis of shallow foundations; Geotechnical design of machine foundation; Deep Foundations- Piles and Piled Foundations, Classification of piles, Load carrying capacity of piles, Pile driving, Settlement of single piles, Settlement of pile groups,

Geotechnical design of driven piles under axial loads, Geotechnical design of driven shafts under axial loading, design of piles under lateral loads, Analysis and design of piles using computer; Deep excavation, Stability Of Excavations-Earth pressure on braced excavations, Stability of excavations in soils; design of anchors and sheet piles.

CV535 Ground Water in Geotechnical Engineering (3-0-3)

Hydrostatic water in soil and rocks, Fluid flow in soil and rocks, Pore-pressure, landslides and slope stability. Groundwater and dams; Groundwater inflows into tunnels; Groundwater inflows into excavations; Flow nets in geotechnical engineering. Detailed Geotechnical design of foundation under groundwater.

CV536 Dam Engineering (3-0-3)

Complex geotechnical Dam Failures ; Site Selection criteria for dams; Environmental impacts of dams; Geotechnical Investigation of dam site; Slope stability; Design of retaining structures; Permeability and Seepage analysis; Laboratory and field determination of seepage of water from soil; Foundation design of dams; Embankment design of dams; Design of filters for dams; Design of earthen dams; Design of concrete gravity dams; Dam safety; Dam monitoring devices.

CV537 Slope Stability (3-0-3)

General Principles of the Behavior of Soft Ground, Field Instrumentation for Soft Ground, Examples of Instrumentation, Applications for Projects in Soft Ground, Behavior of Clay Foundation Soils, Drained and Undrained analysis, Different types of slope failures, their identification, Different method for slope stability analysis, Factor of Safety, Limit Equilibrium Analysis of slopes using software, Methods of Construction, Strategy for Design Studies, Fundamentals of Geosynthetics, Soil-Geosynthetic Interaction, Geosynthetic for Retaining Walls, Geosynthetic for Embankments, Geosynthetic for Shallow Foundations, Geosynthetic for Slopes, Geosynthetic for Earth Dams, Geosynthetic applications-general aspects and selected case studies.

CV538 Geo-environment Engineering (3-0-3)

Types of underground contamination; Sources of underground contamination; Fate and transport of underground contamination; Landfill liners; Compaction of clay soil for clay liner construction; Geosynthetics; Geotextiles; Geonets; Single clay liner and Single Geomembrane liner systems; Recent advances in liner-system for landfills; Leachate removal systems; Closure of landfills.

CV539 Forensic Geotechnical Engineering (3-0-3)

Complex damages, legal terms, dispute resolution, Assignment & Investigations, initial site visits, nondestructive testing, monitoring, lab testing, document search, settlement of structures, expansive soils, backfill settlements, failure analysis of earth retaining structures, highway dip slope slide, tunnels, Repair and crack diagnosis, reducing potential liability

CV631 Numerical Modeling of Porous Media (3-0-3)

Numerical simulations; governing equations of BVP numerical formulations of finite element (FEM) and finite difference models (FDM); limit analysis, lower and upper bond solutions of bearing capacity problem; Soil behaviour under shearing; constitutive models parameters, selection and calibrations; theory of plasticity, yield surface, hardening law and flow rule, Tresca and Von Mises plasticity models; Numerical modeling of excavation/tunnel/foundation problem, selection of constitutive model, selection of shear strength and stiffness parameters, boundary conditions, verification/validation of numerical model, interpretation of results and development of guidelines for numerical simulations in geotechnical engineering design practice.

CV632 Soil Dynamics (3-0-3)

Wave propagation in unbounded media, 1D & 3D wave propagation theories, waves in infinite body, waves in layered body with inclined wave propagation cases, attenuation of stress wave, material and radiation damping, soil dynamic properties, stress-strain behavior of cyclic loaded soils, equivalent and nonlinear soil models, strength of cyclically loaded soils.

CV633 Advanced Rock Mechanics (3-0-3)

Application of rock mechanics; Investigation of rock masses; Classification of rock masses their applications and limitations; Characteristic and strength of rock joints, flow in joints, coupled properties, joint testing; Rock parameter assessment; strength and failure criteria, anisotropy, dynamic strength, rock material

testing; Rock slope stability analysis; Stereo nets, Analytical and numerical analyses of rock masses including example applications to rock slopes.

CV634 Underground Excavation and Tunneling (3-0-3)

Rock and soil mechanics applied to tunneling; Tunneling construction methods and technology; Stress around opening and ground response; Convergence-confinement method; Ground-support interaction; Tunnel failure and support mechanisms, Observational based support method; Tunnel support design using rock mass classification systems; Segmental lining design, settlements in soft ground tunneling; Numerical modeling of tunnels.

CV635 Geotechnical Earthquake Engineering (3-0-3)

Local site amplification effects, use of nonlinear hyperbolic constitutive model, soil-structure interaction considering kinematic and inertial interactions, analysis and design of retaining walls, seismic pressure on yielding and non-yielding walls, seismic slope stability analysis considering limit equilibrium, stress-deformation analysis, valuing deformation of underground structures subjected to dynamic loading, dynamic analysis of dams considering soil-structure interaction, dynamic analysis of tall building, direct and substructure modeling approaches, earthquake provision in building codes and regulation

CV636 Un-saturated Soil Mechanics (3-0-3)

Nature and genesis of unsaturated soils: phase properties and relations, air-water solid interface, in-situ stress state component profiles, suction and potential of soil-water system, transient suction and moisture profiles, compaction; Soil suction: Suction component, principle and measurement of total suction, matric suction, osmotic suction, capillarity; State of stress and shear strength: Stress state variables, material variables, effective stress concepts for unsaturated soils, representation of net normal stress, matric suction and suction stress tensor, stress control by axis translation. Shear strength of unsaturated soil, extended Mohr-Coulomb criterion, shear strength and pore pressure parameters, measurements of shear strength parameters; Flow of water in unsaturated soils: Soil-water characteristic curve (SWCC), hysteresis in SWCC, permeability and hydraulic conductivity function, direct and indirect measurements of SWCC and hydraulic conductivity function. One-dimensional consolidation and swelling for unsaturated soils; Applications: Applications of unsaturated material properties in geotechnical and geo-environmental structures.

CV637 Ground Improvement and Geosynthetics (3-0-3)

Ground improvement methods, Electro-osmosis and ground freezing, compaction near field, compaction at greater depth, soil stabilization, grouting, earth reinforcements, Geosynthetics, geotextiles, geogrids, recomposites, geocells, vertical drains and pre-consolidation, stone colums, ground anchors, soil nailing, problematic grounds and its remedial, Experimental and numerical simulation of ground improvement using geosynthetics

CV638 Geo-Sensing and Measurements (3-0-3)

Role of sensors in addressing geotechnics related world problems, State of art geo-sensors and applications in geotechnical measurement, soil and groundwater decontamination using electrochemical technologies, and on application of fiber-optic and wireless sensors for distributed measurements in geo-media and civil infrastructure, application of direct current electric field for in-situ destruction of contaminants through enhanced redox in clay-rich soils, application of distributed fiber-optic and wireless sensor networks for detection of soil water and contaminants, and infrastructure health monitoring in subsurface

CV639 Earthquake Seismology and Hazard (3-0-3)

Earthquake generation, magnitude recurrence relationships and their applications, ground shaking from earthquakes and accelerograms, Probabilistic seismic hazard assessment, Seismic hazard mapping, Site classification system, site amplification, liquefaction, Causes of tsunamis, Earthquake and tsunami impacts, Earthquake risk assessment, Technologies and researches in state of art early warning system for earthquake and tsunami, Development of earthquake resilient communities and regional demonstration projects, Simulation of 2005 AJK earthquake and evaluation of current state of earthquake resilience system available in Pakistan.

CV511 Advanced Structural Analysis (3-0-3)

Review of fundamental principles of structural analysis, analysis of complex planar structure using Classical methods like Moment Distribution, Slope Deflection, Column Analogy, Consistent Deformation, Matrix methods and their applications to simple planar structures.

CV512 Advanced Structural Mechanics (3-0-3)

Revision of Fundamental Statics, Simple Structures, Pin jointed Frame structures, shearing Forces and bending Moment Diagrams, Stress analysis (Direct Stress), Bending stresses, Combined Bending and direct stress,

Shear Stresses, Tensional stresses, Stress Transformation and Mohr's circle Stress, Composite sections, Beams deflections and rotations, Strain energy, Virtual work, Three-dimensional theories of stress, Three-dimensional theories of strain, Hooke's law for orthotropic materials, Yield Criteria, Energy methods, Torsion of non-circular sections, Unsymmetrical bending, Flexural stresses in curved beams, Shear center, Thick-wall cylinders, Flat plates, Fracture mechanics, Contact stresses, Applied elasticity.

CV513 Advanced Concrete Technology (3-0-3)

Aggregate assembly, cement hydration and microstructure, Properties of fresh concrete, Chemical and mineral admixtures in concrete, Mechanical properties of concrete, Dimensional stability of cement-based materials, Special concretes, High performance concrete, Self-consolidating concrete, Fiber reinforced concrete, Lightweight concrete, Polymer modified concrete, Sprayed concrete (shotcrete)

CV514 Advanced Pre-Stressed Concrete (3-0-3)

Design Considerations, Pre-stressing Techniques, Materials, Analysis of Pre-stress members, Stresses at various stages of Pre-stressing, continuous Pre-cast Pre-stressed structures, moment-curvature relationship, deflection, draped strands, and losses in Pre-stress. Design project or term paper.

CV515 Advance Concrete Design (3-0-3)

Design of Reinforce Concrete Structures for Gravity & lateral loads, various structural systems, Design of Flat Slabs (by DDM, EQM), Shear wall, Shear Wall Frame Interaction, Design of various structural joints such as Beam Column joints etc. Yield line analysis of slabs and design.

CV516 Advanced Steel Structures (3-0-3)

Design Philosophies, code and specification, behavior and design of Building system, members with axial load and bending, Elastic frame behavior and bracing system, Behavior and design of connection, Plate-girder Design, Design Project or term paper.

CV517 Computer Aided Analysis and Design of Structures (3-0-3)

This course will teach students to produce 3-dimensional models and engineering drawings of structures. Students will be introduced to model topography and conceive architectural and structural features in modeling tasks. Students will complete conceptual designs of civil engineering systems and apply modern Computer Aided Design (CAD) and Building Information Management (BIM) software. Engineering codes and limit states design are introduced, and loads will be calculated according to the applicable international engineering. By the end of this course, students will be able to model, analysis, design and prepare working drawings of sizeable projects.

CV518 Design of Masonry Structures (3-0-3)

Overview – History of Masonry Construction, Properties and Testing of Masonry Units, Mortar and Grout, and Masonry Systems, Cracks and Crack Control, Construction Procedures and Details, Design Codes and Design Loads, Design of Curtain Walls - Unreinforced and Reinforced, Design of Interior Bearing Walls -

Unreinforced and Reinforced, Design of Exterior Bearing Walls - Unreinforced and Reinforced, Design of Columns, Piers, and Pilasters, Diaphragm/Shear wall Analysis and Design.

CV611 Dynamics of Structures (3-0-3)

SDOF, MDOF and Continuous Systems. Formulation of equation of motion for SDOF systems, Principles of Analytical Mechanics, Response of SDOF and continuous systems to Damped and Un-Damped, free, forced harmonic and general dynamic loading and transient response. Approximate and numerical methods for analysis of SDOF and continuous systems. Analysis of response in the frequency domain, Wave propagation analysis.

CV612 Earthquake Engineering (3-0-3)

Scope of earthquake engineering, Elements of seismic hazard analysis, Elements of seismic analysis methods, modal analysis of linear multi-degree-of-freedom systems subjected to ground excitations and understand the architecture of computer platforms capable of performing such analyses on complex structural systems, rapid spectral analyses of multi-degree-of-freedom systems subjected to earthquake ground excitations, static nonlinear analyses of multi-degree-of-freedom systems, nonlinear time-history dynamic analyses of multi-degree-of-freedom systems subjected to ground excitations, Incremental Dynamic Analyses, Elements of seismic design, Elements of energy concepts in earthquake engineering, Elements of passive supplemental damping and seismic isolation.

CV613 Structural Design Optimization (3-0-3))

Review of numerical optimization methods, Structural applications of linear and discrete methods, Approximation techniques, Sensitivity analysis techniques, Decomposition and multidisciplinary optimization, Reliability based design optimization.

CV614 Bridge Engineering (3-0-3)

Bridge Elements, load (AASHTO code, code of practice in Pakistan), Analysis and Modeling Technique, simplified live load distribution procedure, influence lines and surfaces, Design of steel/Pre-stress bridges, sub-structure design, Design Project or term paper.

CV615 Wind Engineering and Structures (3-0-3)

Application of Wind Engineering, Damages of Structures Caused by Wind, Similarity Law, Fundamental Equations, Dimensional Analysis Natural Wind Cause of Wind Modeling of Natural Wind Estimation of Extreme Wind Response of Structures to Wind Aerodynamic Forces Static Response of Structures Dynamic Responses of Structures Aerodynamic Instability Galloping Vortex Induced Vibration Wind Tunnel Test and Numerical Simulation Wind Tunnel Test Computational Wind Engineering

CV711 Modeling of Concrete Performance (3-0-3)

Overall strategy for multi-scale & multi-chemo-physics modeling, Modeling of chloride transport and binding in hydrated cement, Infrastructure maintenance with simulation approach, Mass conservation of moisture in concrete and moisture equilibrium & transport, Modeling of airborne chloride transport and its migration into concrete, Evaluation of liquid water penetration rate into concrete, Air transfer mechanism in concrete and non-destructive testing, Environmental issues in concrete industry, Study on concrete properties with various testing methods and apparatus, Cement hydration and strength development, Fluidity and rheological property of fresh cementitious materials

CV712 Nonlinear Analysis in Civil Engineering (3-0-3)

Mathematical preliminaries; Solution of equation in one variable; Interpolation and polynomial approximation; Numerical differentiation and integration; Initial-value problems for ordinary differential equations; Iterative techniques in matrix algebra; Approximation theory; Approximation eigenvalues; Numerical solutions of nonlinear systems of equation; Boundary value problems for ordinary differential equation; Numerical solution to partial differential equation. Basics of plasticity, explicit and implicit algorithms for integrating the rate form of plasticity with geometric explanations, consistent tangent operators for implicit algorithms, basics of large deformation, standard and advanced algorithms for solving large deformation problems.

CV713 Special Topics in Structural Engineering (3-0-3)

To introduce special research-oriented problems in structural engineering. Contents to be decided by the Professor with due approval from Chairman Civil Engineering Department.

Research Groups

Research Groups, Industrial and International Linkages

The Research Group for the Department of Civil Engineering at GIK Institute proudly presents its diverse areas of expertise and international collaborations. Comprising three key research areas, we engage in pioneering work, collaborate with global partners, and contribute to cutting-edge advancements in the field of civil engineering.

Research Group: Smart Materials and Design

Smart Materials, led by Prof. Dr. Muhammad Ashraf Tanoli, represents a frontier in civil engineering, revolutionizing construction through innovative materials and techniques. Collaborations with prestigious institutions and industrial partners enable GIK to drive advancements in digital construction covering sustainability, and performance of structures.

Team Leader

Prof. Dr. Muhammad Ashraf Tanoli

Team Members

Dr. Rao Arslan Khushnood

Dr. Hafiz Ahmed Waqas

Research Labs

Concrete Lab

Computing and Simulation Lab

International Collaboration

Shanghai Jiao Tong University, China

University of Illinois Urbana-Champaign, USA

Industrial Collaboration

WAPDA

Creative Engineering Consultants

Research Group: Natural Hazards Assessment and Risk Mitigation

This field is critical in addressing the escalating threat of natural disasters, as it helps identify risks and develop strategies to safeguard lives and infrastructure. Through international and industrial collaborations, our research group plays a vital role in enhancing disaster resilience and ensuring the safety of communities.

Team Leader

Dr. Mehtab Alam

Team Members

Dr. Hafiz Ahmed Waqas

Dr. Muhammad Waseem

Research Labs

Geotechnical Lab

Hydraulics and Hydrology Lab

Computing and Simulation Lab

International Collaboration

Institute of Mountain Hazards and Environment, China

China Pakistan Joint Research Center for Earth Science, Islamabad

Industrial Collaboration

Galiyat Development Authority

Research Group: Sustainable Infrastructure Management and Automation

Led by our dedicated team, our research group specializes in the application of disruptive technologies to solve issues of construction and mobility sector, driving advancements towards smart cities and sustainable society. Through international collaborations and participation in key conferences, we are at the forefront of shaping the future of construction technology and management.

Team Leader

Dr. Shiraz Ahmed

Team Members

Dr. Numan Khan

Research Labs

Autocon Lab

Computer and Simulation Lab

International Collaboration

Collaboration with Chung-Ang University, Seoul, South Korea.

School of Surveying and Built Environment (SBE), University of Southern Queensland

Industrial Collaboration

J7 Group of Companies

Creative Engineering Consultant

School of Management Sciences

THRUST AREAS

ENGINEERING MANAGEMENT

Dean
Sami Farooq
PhD (University of Nottingham, UK)

FACULTY

Prof. Muhammad Sabir	PhD (Vrije University Amsterdam, the Netherlands)
Yousaf Ali Khan	PhD (University of Macerata, Italy)
Abid Ullah, PhD	PhD (Ural Federal University, Russia)
Bushra Sarwar	PhD (University of Science and Technology, Beijing, China)
Muhammad Zeshan	PhD (Sorbonne Business School, University Paris, France)
Suhaib	PhD (Koç University, Istanbul, Turkey)
Muhammad Ullah	PhD (University Clermont Auvergne - Clermont-Ferrand, France)
Ubaid Ullah Mumtaz	PhD (University of Western Australia)
Saima Aftab	PhD Foundation University Islamabad, Pakistan
Muhammad Faisal Rasheed	PhD Aix, Marseille University, France.

Introduction:
Globalization has brought new challenges of sustainability, health, environmental protection and a new breed of managers is required by companies and organizations, to meet these challenges. The Master of Engineering Management (MEM) degree program is geared towards helping engineers/technologists develop planning, decision making and managerial skills while receiving advanced technical knowledge. It is intended to prepare graduates of accredited engineering programs with the management skills needed to provide engineering leadership in today's multi-disciplinary business environments and technology commercialization projects. The primary focus of the program is towards management and entrepreneurship, which are the essential components for building new and spin-off technologies for development of engineering products and new venture creation.

Program Educational Objectives (PEOs):
The program objectives are:
1.Producing graduates having knowledge and critical skills to research and analyze engineering and management problems, design feasible alternatives and have competence to address them in their professional life.

2.Producing professionally competent graduates who are able to work on industrial assignments, can work effectively as a team member and demonstrate leadership qualities to excel in their profession.

3.Producing graduates who are capable of taking entrepreneurial initiatives and advance their knowledge by blending theory with practice.

4.Producing graduates who have a sound technical knowledge and are capable to design and develop efficient systems/processes using quality and lean management tools.

5.Producing graduates with relevant knowledge of engineering and management practices including ethical, professional and social awareness that have an impact on stakeholders.

Program Learning Outcomes (PLOs):
The MS Engineering Management program is designed with the following core outcomes:

1.Able to utilize the relevant knowledge and critical skills to research and capable to respond to challenges in the domain of engineering and management and apply data-driven solutions in a highly dynamic and competitive environment.

2.Able to identify, formulate and solve practical engineering and management problems and can make sound decisions in their professional setup to meet their organizational needs.

3.Able to use modern tools, techniques and skills and can take advantage of problem-solving and team building skills and in turn reflect high degree of productivity.

4.Able to use technical knowledge, data analysis and optimization techniques relevant to the field of engineering and management.

5.Able to identify and understand professional and ethical issues within an organization and recommend solutions in the light of ethical theories.

Course Work
MS degree in Interfaculty Engineering Management will be based on 7 – 8 courses from the list given below. Three courses are mandatory from the core requirement, while remaining can be selected based on the field of specialization in research topic for MS thesis.

Core Courses:

EM522	Engineering Management
EM571	Marketing Management for Engineers
EM521	Operations Management
EM581	Supply Chain Management

Elective Courses:

EM523	Industrial Safety
EM541	Environmental Engineering
EM582	Quality Management and Lean Enterprises
EM501	Inferential Statistics
EM572	Techno Entrepreneurship and Intrapreneurship
EM551	Corporate Governance
EM542	Sustainable Development
EM561	Project Management
EM524	Human Resource Management
EM502	Quantitative Decision Analysis
EM543	Macro and International Economics
EM552	Industrial Costing Management
EM544	Industrial Economic Strategy
EM553	Finance and Accounting for Engineers
EM525	Change and Crisis Management
EM526	International Business
EM503	Advance Research Methods
EN511	Manufacturing Technology
EN537	Energy Conservation and Management
EN572	Thermal and Nuclear Power Plants

Thesis:

EM591	MS Thesis (3)
EM592	MS Thesis (3)

Course Description of MS Engineering Management Program

CORE COURSES

EM522: Engineering Management:
Management principles; Managers and Managing; History of management; Scientific Management; The environment of management; Planning process and strategic management; Managerial decision making; Leadership; Motivation; Organizational communication; Human resource management; Controlling; Promoting innovation and entrepreneurship.

EM571:Marketing Management for Engineers:
Marketing Management is the art and science of choosing target markets and getting, keeping, and growing customers through creating, delivering, and communicating superior customer value. Marketing management seeks to meet organizational objectives by effectively satisfying customers in a dynamic environment. In this course, students will learn how businesses create value for customers. Students will also learn the process by which marketing builds on a thorough understanding of buyer behavior to create value. They will also learn the major elements of the marketing mix - product policy, channels of distribution, communication, and pricing - and see how they fit within different analytical frameworks that are useful to managers. This will enhance students understanding of how marketing works in the business world.

EM521: Operations Management:
Introduction to Operations Management; Process Analysis; Constraint Management; Product design; Process Strategy; Operations Strategy; Quality Management; Lean Management; Supply Chain and Inventory analysis; Forecasting; Resource planning; Scheduling.

EM581: Supply Chain Management
Given how quickly and continuously everything is changing these days, it is essential to understand analytically the functioning of supply chains and to be able to know what strategies will produce the best results. This requires greater attention to creating supply chain solutions that are effective and efficient. This Subject links Supply Chain management to the major functions of the organization. It reviews the nature of operations and supply chain with respect to all types of business. Special topics include Value and supply chain, Demand forecasting, Inventory management, Resource management, Process management, Logistics Management, and advance concepts such as Industry 4.0 and industrial automation. This subject also develops student's communication skills and ability to analyze and consolidate complex information.

ELECTIVE COURSES

EM523: Industrial Safety:
Accidental prevention; Ergonomics and protective equipment; Fire prevention and control; Concept of total loss control.

EM541: Environmental Engineering:
Combustion and air pollution (ozone, urban smog, acid rains); Industrial emissions (flu, ash, flue gasses, particulate matters, smoke, soot); agro chemicals land and water pollution; transportation pollution; domestic and industrial waste water treatment (primary, secondary and tertiary); solid waste management (incinerators); role of catalysis in environmental engineering; nuclear waste management; energy conservation technologies; Heating; ventilation and air conditioning (HVAC)related environmental issues; Green technologies and renewable energies; environmental impact analysis; policies and regulations, resource depletion and substitution; three Rs: reduce, reuse & recycle.

EM582: Quality Management and Lean Enterprises

Quality Management (QM) or Total Quality Management is a philosophy, methodology and system of tools aimed to create and maintain mechanism of organization's continuous improvement to compete in the marketplace. It involves all departments and employees into improvement of processes, services and products. It helps to reduce costs and to meet and exceed needs and expectations of customers and other stakeholders of an organization. QM encompasses the concepts of business and social excellence that is sustainable approach to organization's competition, efficiency improvement, leadership and partnership. The aim of this course is to introduce the main principles of business and social excellence, to generate knowledge and skills of students to use models and quality management methodology for the implementation of total quality management in any sphere of business and public sector. Furthermore, the students will also learn the concepts of Lean & Six Sigma (LSS) methodologies, tools and principles and their significance for enterprises.

EM572: Techno Entrepreneurship and Entrepreneurship

This course introduces graduate students to the theory of entrepreneurship and its practical implementation. It focuses on different stages related to the entrepreneurial process, including business model innovation, small business management as well as strategies that improve performance of new business ventures. Centered on a mixture of theoretical exploration as well as case studies of real-world examples and guest lectures, students will develop an understanding of successes, opportunities and risks of entrepreneurship. The course will enable the students to launch their ventures successfully. Furthermore, this course will develop graduate students abilities to plan and execute on Intrapreneurial initiatives in existing organizations, both as an Intrapreneur, and as senior management building corporate entrepreneurship into the organization.

EM551: Corporate Governance:

Corporations and Corporate Governance; Systems of CG; International Environment for Corporate Governance; Corporate Governance Framework; The Board of Directors; Shareholders and Shareholder Activism; Executive and Non-Executive Compensation and Incentives; Financial Controls; Auditing & Disclosure; Corporate Takeovers; Mergers & Acquisitions; Risk Management; Role of Financial Institutions in Corporate Governance; Corporate Social Responsibility.

EM542: Sustainable Development:

What is development? Concept of sustainable development; MDGs in Pakistan; Agriculture; Nutrition; Interrelationship of economics; trade policy and development; role of technology and engineering in development; energy and development; policy and migration; community participation; climate change and energy crises; health; ethics; management for development.

EM524: Human Resources Management

This course examines the role of the human resource professional as a strategic partner in managing today's organizations. Key functions such as job analysis, HR planning, recruitment, selection, development, appraisal, retention, compensation, and labor relations are examined. Implications of legal and global environments are appraised and current issues such as diversity training, sexual harassment policies, and rising benefit costs are analyzed. Best practices of employers of choice are considered.

EM502: Quantitative Decision Analysis

This course is designed to help students learn a logical, rational approach to the decision-making process. The title of the course, Quantitative Decision Analysis, suggests that mathematical and statistical modeling is used to aid us in the decisions process. Many managerial problems revolve around quantitative factors such as production quantities, revenues, costs, and so on. While students may never have to solve complex, real world, problems using the techniques covered in this course, understanding how they work will prepare them to be a more effective executive. By incorporating these quantitative factors into a mathematical model and then applying mathematical procedures to solve the model, this course provides a powerful way to analyze managerial problems. In the world of Big Data, Predictive Analytics, and Sales & Operations Planning, a good understanding of the methods presented in this course is a must for any Master program in Management.

Quantitative Decision Analysis Covers the theory and practice of decision analysis and risk assessment. Covers decision theory, game theory, utility and risk attitude, probability assessment, multi criterion decision making models. Describes practical applications through real-world engineering /project management decision analysis applications. Computer applications.

EM543: Macro and International Economics

The main objective of this course is to give students an understanding of the working of socialist, capitalist and mixed economy at the aggregate level. The basic themes are extended to explore the disciplines of national income, public finance, macroeconomics in closed and open economy, macroeconomic stabilization policies, money and banking link up with conventional macroeconomics.

EM553: Finance and Accounting for Engineers

This introductory course in Finance and Accounting is for students having no or limited prior accounting and finance knowledge and provides an understanding of how funds are raised and utilized and how financial statements are prepared for various types of organizations.

The course is designed to provide and create an understanding of basic Finance and Accounting terms and concepts, to familiarize with the concepts of Time Value of money, Capital Budgeting, Capital Structure, determination of income / loss for a certain period and financial position at a certain date, to develop an understanding of the accounting cycle and financial statement analysis.

EN537: Energy Conservation and Management:

Energy Auditing; Energy Bills; Energy management in thermal and electric utilities including HVAC; Steam generation and distribution; Compressor and compressed air systems; Fans and Blowers; Pumps and pumping systems; Cooling towers; Insulation; power generation; Lighting; Cogeneration; Furnaces and refractory; waste heat recovery etc.

EN511: Manufacturing Technology:

Manufacturing operations; automation systems; statistical process control; materials and advanced materials and Properties; advanced processes; Joining and Fabrication; Plant Design and Materials Handling; Production Planning; Concurrent Engineering; Reverse Engineering; Flexible Manufacturing System; Computer integrated manufacturing (CIM); process quality evaluation; six sigma and nine sigma; lean and Agile manufacturing; Production and Cost Analysis.

EN572: Thermal and Nuclear Power Plants:

Thermal power plant environment impact assessment; Thermal power plants operation (fuel type, thermodynamics); Gas Turbine Materials and Technology; Compressor; Turbine; Burners; Combustion Chambers; Combustion chemistry; Generators and auxiliary systems (Heat transfer & Gear assemblies); Power plants control and instrumentation; Water treatment for steam generation; cooling towers; Nuclear Reactions; Reactor components and their characteristics; Introduction to fast and fusion reactor systems Reprocessing of irradiated fuel; Process waste disposal & Radiation hazards; Interaction of radiation with matter; Neutron sources; Neutron detection techniques and neutron spectroscopy; Control rods;

Materials for Nuclear power plants; Nuclear power plants; Design and Construction; Safety of nuclear plants; Plant safety & maintenance; Radiation control and safety.

EM501 Inferential Statistics

Inferential statistics allows us to draw conclusions from data that might not be immediately obvious. This course focuses on enhancing your ability to develop hypotheses and use common tests such as t-tests, ANOVA tests, and regression to validate your claims. Topics covered include estimating parameters of a population using sample statistics, hypothesis testing and confidence intervals, t- tests and ANOVA, correlation and regression, and chi-squared test.

EM 503 Advance Research Methods

This course will provide a background and analysis of the interpretive act in all educational research. Designed to provide an in-depth study of the process of conducting research in the naturalistic paradigm, the course focuses on an examination of the major methodological traditions of this approach to research. Also included are the terminology and a consideration of the distinctions between the naturalistic and the rationalistic, or quantitative, methods of inquiry. The Research Methods Course provides the knowledge and understanding of research design and methods appropriate for small-scale research. It is concerned with the formulation of research questions or hypotheses and the design of the research process and the ensuing process of investigation

EM 561 Project Management

This course guides students through fundamental project management concepts and behavioral skills needed to success-fully launch, lead, and realize benefits from projects in profit and nonprofit organizations. This subject will equip the students to successfully manage projects and their resources by exploring the Project Management Body of Knowledge which describes the knowledge within the profession of project management. This course will guide the students through all the knowledge areas and project processes identified by PMBOK. This course will also teach students about the basics of Project Management Software's. Upon successful completion of this subject the students will be able to apply project management practices principles, processes, tools, techniques, key skills, and applied knowledge to their work to satisfy their customers and other people involved in and affected by the project.

EM525 Change and Crisis Management

Although change is ever-present in organizations today, a crisis can result from anything an organization is unprepared to deal with. Successful crisis management aims to minimize the impact of disruptive events that can result in loss of life, equipment, earnings, customers, reputation, market share or other future business prospects. The aim of this course is to provide students insights regarding key concepts, theoretical perspectives, essential skills and abilities, critical thinking and problem-solving skills necessary for effective change and crisis management within organizations.

EM544: Industrial Economic Strategy:

This course will cover various dimensions of industrial economics and strategy. The course will cover topics in basic economic theory, organization and market structures and firms' behavior in a strategic competitive environment. Topics will also include public policy and its importance for business strategy. Overall, this course will provide essential analytical tools to students for making informed business decisions under different market conditions.

EM552: Industrial Costing Management:

This course focuses on the use of accounting information to report managerial performance and to facilitate business decisions. It covers the preparation and use of cost and management accounting information in planning, budgeting, break-even analysis, income determination, product costing, process control, corporate financing and capital structure decision making.

EM526: International Business:

This course aims to provide the students with an overview of the unique problems faced by firms engaging in international activities; the importance of understanding the foreign economic, social, political, cultural and legal environment; the mechanics of importing and exporting; joint venture, franchising and subsidiaries; international dimensions of management, marketing and accounting, international financial management. The course also delves into the special problems of multi-national corporations; recent problems of the international economic system; country-risk analysis; the increasing use of counter trade.

Research Groups

Main research areas in Engineering Management include:

Group A: Operations & Supply Chain Management

Prof. Sami Farooq
Dr. Yousaf Ali Khan
Dr. Suhaib
Dr. Ubaid Ullah Mumtaz
Mr. Hassan Tariq

Group B: Accounting Finance & Economics

Prof. Muhammad Sabir
Dr. Bushra Sarwar (On Leave)
Dr. Muhammad Ullah
Mr. Waqas Rehman
Ms. Umme Rabab

Group C: Strategy, HRM, Entrepreneurship and Marketing

Dr. Abid Ullah
Dr. M. Zeshan
Dr. Saima Aftab
Dr. Faisal Rasheed
Mr. Haroon ur Rasheed
Mr. Shahzeb Fayyaz (On Study Leave)
Group D: Social Sciences/ Humanities
Mr. Abrar Ahmad
Ms. Hira Ahad
Mr. Atta ur Rehman Jadoon
Mr. Haseeb Ahsan
Ms. Tayyaba Zulfiqar
Mr. Izhar Ali

International Collaborative Agreements/MoU:

MoU with Ural Federal University Russia, Focal Personal: Dr. Abid Ullah signed on 25th August 2022.

National Collaborative Agreements/MoU:

GIKI & NBEAC, to strengthen collaborative activities and areas of mutual interest between the GIK Institute and NBEAC, Islamabad signed on 1st July 2022.

Almuni/ Student Impressions

Ghulam Ishaq Khan Institute was a life-changing institute for me. I'm forever indebted to FCSE and GIKI for giving me a scholarship for master's studies. I strongly recommend GIKI for graduate studies; there is a small graduate community, focusing on quality education and research, and there are various scholarships. Also, different teaching placements during the labs will be an invaluable experience for every graduate. Once, the secretary of FCSE told me that GIKI is a launching pad; I got my first job at FAST-NU as a lecturer before I even defended my master thesis. I also got 3-4 offers for my PhD studies, and now I am doing my PhD at Monash University (Globally ranked#58). GIKI is the reason for who I am today.

(Shahid Iqbal- Centre for Data Science and Biomedicine Discovery Institute, Monash University, Clayton Australia)

Choosing GIK for the MS program was one of the best decisions of my life. GIKI's environment from an academic and living point of view is an incredible experience. It collects the best students from diverse cities in Pakistan and provides them the opportunity to interact with students of different backgrounds to learn, explore, and groom. I am thankful to all the FCSE faculty members for their continuous efforts and support. It has changed my way of thinking and taught me to dream big. The faculty of computing is well-organized from every perspective. The teaching method of FCSE and their way to figure out the research capability and the area of interest in individual students is worth appreciating. The GIK offers the graduate student the opportunity to conduct labs and assist teachers to improve their confidence and polish their presentation skills. Apart from this, the FCSE develop positive competition among the students as well in the faculty. Due to this, graduate students can complete their degrees timely and publish their thesis in reputable journals. Based on my wonderful experience as a master's student at FCSE, I decided to take admission in the Ph.D. program which was the second-best decision of my academic career. I am very thankful to the FCSE for providing us with the research facilities. This enhanced my enriched my research potential further and thus I confidently got over the obstacles in my research projects, completing my Ph.D. within the required time, and published my work in high impact journals. I have adequate experience in teaching and supervising students during research at GIK where I stayed for six years (MS and Ph.D.) and established a good working relationship with the staff, as well as the students.

(Dr. Uzma- Research Associate at the University of Glasgow)

I am a computer engineering graduate from GIK Institute, Pakistan. Currently, a doctoral student and MEXT scholar at The University of Tokyo, Japan. From a young age, I have always been fascinated by the diversity different cultures offer. The reason for choosing GIK Institute for master's degree program was to live this experience. Students from all around the country gather and study like a family in GIK Institute because we live, play, study, and socialize altogether. The institute encourages cultural diversity in the classrooms to foster inclusion and awareness around multicultural education and this approach to teaching benefits all students. The graduate program of the institute offers a challenging and demanding classroom environment that developed my ability to make justifiable conclusions in my research problems. I have been able to acquire motivational and leadership tools by working in Graduate Student Society during my studies to achieve interpersonal skills in extracurricular activities of the GIK Institute for example, hands-on workshops, research seminars, programming competitions, sports, music concerts, hiking trips, and community service activities, just to name a few. My life in the institute prepared me to ideal start my career in Japan because I have taken every opportunity to gain experience from highly experienced professors and mentors. The strong inclination towards research problems set a foundation for me to gain knowledge and experience from abroad to serve community. I am thankful to GIK Institute for it has pushed me to seek new experiences and find what I am passionate about.

(Iffat Maab- University of Tokyo)

GIKI is indeed one of the best place to study in. Specially, the experience of being a graduate student. It really makes feel confident to compete in a competitive environment. Moreover, the faculty members have always been nice and cooperative. I am proud to be a GIKIAN.

Dr. Abdul Kabir Khan
Assistant Professor of Physics and Mathematics at Department of Space Science Institute of Space Technology Islamabad 44000, Pakistan.

When I was doing my Bachelors it was my dream to do my master studies from GIKI and win a scholarship at this prestigious institute. By the Grace of Allah Almighty I got a fully funded scholarship at GIKI and enjoyed the best teaching faculty there. GIKI provided me with the main stage for my personal and professional grooming. It gave me a chance to work with the competent faculty and refine my research skills by working in a laboratory enriched with state of the art simulation software under the supervision of Engr. Dr. Muhammad Usman. It has provided me with a number of opportunities to exhibit my talent and learn from the experience of my proficient teachers and seniors. After completing my masters degree from GIKI I got several offers of fully funded PhD scholarship in Europe and Mexico. And last year I aced my interview for the position of early stage researcher under the Marie Curie funded research project (FoodTraNet). Here, I am working for the development of novel edible photonics barcodes for the food tagging and tracing.

Abdur Rehman Anwar - MS Graduate from Faculty of Engineering Sciences

Being a part of Ghulam Ishaq Khan (GIK) institute of Engineering Sciences and Technology, I got a chance to find my interests and polish my skills. The most important part of this university, however, is the integration of the diverse flavours that are represented by the people that come here from all over Pakistan. The faculty and staff of Engineering Sciences (ES) are very encouraging and helpful. They helped me grow not only in academics but also as a human being. I learnt to balance my social life and work. GIK taught me how to be productive under stress. It also taught me to not worry about things too much because everything happens for a reason. GIK gives you a hard time, but it's all worth it in the end.

Saad Rasheed (MS Applied Physics)
Graduate Assistant, (ES2052) GIK Institute, Pakistan

Joining GIKI for graduate study was, without a doubt, the best move I've ever made in my academic life. Students are encouraged to be autonomous, creative researchers, and the faculty encourages and supports their development in this capacity. GIK provides an ideal research environment with highly competent faculty. The vibrant culture and immense cultural exposure make a stay at GIK a once-in-a-lifetime opportunity. This incredible opportunity to be a part of such a reputable institute will undoubtedly help me begin my professional career.

Shabeela Malik
(ES2017) - PhD. Scholar

GIKI being my second home, played a vital role in my academic and natural development. Master in Engineering Management paved the path for me to step into the world of academic research. The foundation that was laid out for me, helped in landing a prestigious fully-funded Italian government scholarship for my Ph.D. Currently, I am studying in the 2nd year of my Ph.D. in Quantitative Methods for Policy Evaluation. With the world-class facilities and the great social life of GIK along with the help of the top-notch faculty of the School of Management Sciences, I am able to make my parents and my country proud.

Amin Ullah Khan-(2018-2020)

I did my Master in Engineering Management from the School of Management Sciences, Ghulam Ishaq Khan (GIK) Institute of Engineering Sciences and Technology back in 2019. Currently, I am doing a dual Ph.D. in Management with a specialization in supply chain management from NEOMA Business School, France, and Université de Reims Champagne-Ardenne, France. I believe that choosing GIK for my graduate studies and switching from pure Engineering background to Management was the best decision I could have made. The GIK Institute offers a high-quality master's program, which allows me to immerse myself in the studies both academically, personally, and professionally. The faculty, environment, and the standards of academics here push the student's limits to their intellectual and creative energy, which makes the campus vibrant. I would recommend it to anyone.

Jehangir Khan (MS Engineering Management 2017-2019)

Being a part of the GIK is the best decision of my life. It helps me understand myself and my true passion. Master in Engineering Management helped me learn a lot and improved my skills. The institute has a specialized method of improving your soft skills. Every department has a research-oriented environment and the faculty is cooperative. Taking the advantage of a beautiful residential campus, students enjoyed a very interactive social life and engage in co-curricular on weekends.

Engr. Yasir Khan

My decision to pursue my graduate study at GIK has helped me grow as an individual. The exposure to the different cultures along with the happening environment has been a treat to experience.

Khuzaima Dar, MS Engineering Mangement-2021-2023

I, Engr. Faraz Ahmad did my masters in Mechanical Engineering (2017-2019) from the GIK Institute, one of the most reputable graduate schools in Pakistan. During my stay at GIKI, I worked as a teaching assistant with a senior most foreign professor, Dr. Mykola Bannikov, which accorded me with enough experience to solve multifaceted problems and tackle rigorous questions. My struggle and hard work at GIKI didn't just give me CGPA, rather i got tremendous research and leadership qualities there. I worked under the supervision of Dr. Taqi Ahmad Cheema who helped me more than he could do. In fact, the research environment at GIKI I found was so rich that it made me able to publish my master's thesis in 5 internationally reputable journals. After graduating from GIKI, I joined Air University Islamabad as a lecturer of Mechanical Engineering and served there for 2.5 years. Currently, I am a Fulbright Ph.D Scholar at Purdue University, USA. In short, I realize that I was lucky enough to choose GIK Institute for M.S and this decision became very fruitful. Thanks

Faraz Ahmad- Fulbright Scholar, USA.

Being a technology enthusiast, I always dreamed to study at GIK Institute which is unanimously among the top-notch engineering varsities of Pakistan. I am privileged to be a graduate of the Faculty of Mechanical Engineering GIK Institute with an MS degree. The most valuable lesson GIKI taught me is the attitude of doing things. My life at GIKI was full of enthusiasm, enjoyment, and professional development which enabled me to grow without of box approach. I could secure a fully-funded doctoral position at University of Guelph, Canada. GIKI is where my dream began and I have made some of the best memories in my life.

Malik Hassan

I, Muhammad Suleman did my master's in mechanical engineering with a specialization in thermal fluids from the Ghulam Ishaq Khan Institute of Engineering Sciences and Technology, Topi, Pakistan which is considered as one of the prestigious institutes in the world. Apart from my studies during the two years period, I also worked as a graduate assistant in the faculty of Mechanical Engineering where I taught different labs and assisted bachelor´s courses. Regarding my master´s research, I worked on the HEC funded project titled “Vacuum membrane distillation for seawater desalination” under the supervision of Dr. Muhammad Asif and published my work in top tier journals and conferences. Currently I am working as a Ph.D. researcher in the membrane group at Lund University, Sweden on a European Union Funded project DESOLINATION. In short, I found GIK institute a great place to nurture both my leadership and research skills and I firmly believe that a background from my master´s has prepared me for my current Ph.D. position.

With kind regards,

Muhammad Suleman

Ph.D. Scholar, Lund University, Sweden.

To pursue my PhD in Electrical Engineering, I chose GIK Institute with an ambition to cultivate my scientific research area and teaching toward a field about which I have always been passionate. During my stay here thus far, I have worked closely with my awe-inspiring advisor Dr. Ahmad Kamal Hassan, and TeleCoN Research Group mentors. They have provided me with the guidance and freedom to develop research ideas aligned to my interests. I believe that TeleCoNs have offered me with the helpful, supportive, and affable environment that will help me nurture into a creative, knowledgeable, and independent researcher.

Haleema Sadia (2021)

As a Ph.D. scholar, GIK gave me the opportunity to investigate concepts in the practical research area of High Voltage Engineering. Its graduate assistantship helped me to gain professional teaching and learning experience. The major features of the campus are 24/7 access to research labs and completely residential facilities. Supportive professors and cross-faculty collaboration are extremely beneficial in pursuing higher education.

Muhammad Zaheer Saleem (2019)

With the blessings of Allah Almighty, I got admission in PhD on fully funded scholarship at such a prestigious university of Pakistan. I am pursuing my research under the supervision of highly qualified mentors Dr Arbab Abdur Rahim and Dr Waleed Tariq Sethi at the Electrical Engineering Department of GIKI. They are giving me the room to explore state -of -art research ideas and encouraging me a lot to accomplish my ambitious goals. It is really challenging, yet rewarding, to be surrounded by such extremely smart and experienced people at GIK Institute. But I believe when we do research with smart people; we start to think in a certain smart way too and able to accomplish unbeatable success.

Saba Tariq (2021)

Working on my Ph.D. in the faculty of Electrical Engineering GIK Institute has been an extremely great experience. In a Ph.D. assistantship, GIK provided me with a chance to perform many undergraduate labs, which further improved both my teaching and practical skills. The GIK also provided me a pleasant working environment to conduct the research work. Finally, I rank GIK as one of the best research institutes in Pakistan.

Ahsan Nadeem (2018)

GIKI is a Top leading institute of Pakistan providing the best quality education on full scholarship with an international research environment. I felt blessed to be here as an active member of the TeLeCoN Research Lab under the Supervision of my best mentors, Dr. Zia Ul Haq Abbas, and Dr. Ghulam Abbas. I always found GIKI as my dream place for my graduate studies.

Syed Luqman Shah (2021)

GIK is among few premier institutes recognized internationally by its top-notch educational standards. It provides a conducive environment, especially for interdisciplinary research and extensive coursework. The opportunity for on campus jobs, graduate and research assistantship equips the students with hands on experience of the academic sector which is unmatchable across the country. The GIKI community, at large, welcomes any/every new idea which boosted my confidence of breaking the boundaries. Fully residential campus with access to all facilities, faculty and labs 24/7 broadened my horizon where I found myself reflecting upon the new avenues that I could explore.
(Khadija Akbar Shah-MS Computer Engineering).

With the blessings of Allah almighty, my dream of PhD comes true being a part of prestigious institute of Pakistan. I have secured full scholarship and exploring new research dimensions under supervision of highly qualified mentor Dr.Muhammad Hanif. GIKI is my dream place and I am pretty sure that one day I will touch the heights of sky by exploring my potential to be surrounded by such experienced mentors. Its friendly environment, mentor's behavior , their encouragement and their way of teaching force me to accomplish my goals and to become a valuable member of the society.
(Sania Akhtar-Ph.D. Scholar Computer Science).

"When it comes to acquiring a Doctoral degree, an excellent research atmosphere and university are critical. Ghulam Ishaq Khan Institute (GIKI) provides a fantastic learning and growing atmosphere. I came on board on full scholarship as a Graduate Assistant (GA4) and Ph.D. Computer Science candidate. This was a great decision as GIKI increased my learning potential and provided diverse experiences. The institute is surrounded by stunning mountains that create a wonderful academic setting. When you live on campus, you develop a sense of belonging. I would strongly recommend GIKI to anyone prepared to work hard and study in a dynamic setting. Anyone can reach their goals and do wonders with a little effort."
(Usama Arshad-Ph.D. Scholar Computer Science)

I am very pleased to begin my studies at GIK. The instructors and advisors are fantastic. When I have questions, they are always willing to assist me. My program and teachers are also fantastic. In our classes, we use a variety of technology to help us learn. Professors are quite helpful; they are always willing to assist us with our issues. Teachers here do cutting-edge research in areas such as machine learning, deep learning, and bio informatics. Furthermore, GIK provides me with numerous opportunities. For example, labs are open 24 hours a day, seven days a week, and students are completely hostelite.
(Ietezaz ul Hassan-MS Computer Engineering)

I can state that spending two thrilling years in the challenging environment of GIKI was remarkable. Working as graduate assistant along with studies and research helped me to grow as an individual. GIKI provided a healthy environment for research, I attended two international conferences and published two journal articles while at GIKI.
Jawad Rabbi (gme2124)

7As a mechanical graduate student, I found GIKI to be an excellent research platform. The well-equipped facilities at GIKI allowed me to do research more efficiently. Aside from its resources and facilities, the university has world-class professors, including foreign faculty. The competitive environment on campus has undoubtedly assisted me in achieving my future goals.
Wajeha Bibi (gme2124)

GIK Institute, the place that changed my life towards a new roadmap. I was a part of GIKI for the five constructive years during my MS and PhD and I completed my PhD in July, 2021 in Applied Physics from Faculty of Engineering Sciences. The life in GIKI was phenomenal. I found GIK Institute a best place for research in Pakistan, providing an excellent research facilities, well equipped laboratories and highly qualified faculty. GIKI is a complete package for social and professional development within a beautiful, campus surrounded by lush green mountains, which provides a healthy environment. The hostel facilities are exceptional in GIKI and the hostel life with buddies is unforgettable. Apart from the research facilities, GIKI provides the best mentors to groom and polish the hidden talent of any individual and made them an independent researcher. I will always recommend GIK Institute as a best place to pursue your postgraduate studies in Pakistan.
Dr. Shahid Alam - Assistant Professor- Department of Physics,
Abbottabad University of Sciences & Technology

My name is Tanveer Akbar, and I belong to Swabi. After graduating in Math from Abdul wali khan university Mardan, my interest in applied sciences grew. When I started searching for international standard institutes , the name of a reputable institute like Ghulam Ishaq Khan came up. High quality research in the engineering sciences department forced me to apply to polish my skills. Here I was selected on merit scholarship. Coming here, I found that apart from studies, the standard of this institute is very high in personal grooming, management skills and extra-curricular activities. If you also want to brighten your future, come and be a part of this institute.
Tanveer Akbar - MS Applied Mathematics

I never planned to come to GIK Institute, but when I did, it turned out to be one of the best decisions. Here, I've had the privilege of learning from some of the brightest minds in the field, absorbing their wisdom and enthusiasm for the subject. The camaraderie among students, the collaborative spirit in labs, and the support from faculty create a unique atmosphere where we push each other to excel. The exposure I've gained in this dynamic environment has been invaluable. GIK Institute isn't just an institution; it's a vibrant community where innovation, knowledge, and personal growth thrive. Looking back, I realize that my unexpected journey to GIK Institute has been a remarkable one, shaping my future in ways I could have never foreseen.
Misbah Shaheen - PhD Student (Applied Physics)

GIK Institute is one of the prestigious institutions of engineering in Pakistan and I am honored to be a part of it. GIKI has been more than an educational institution to me; it has been a place of growth, learning, and lifelong friendships. The rigorous coursework, collaborative environment, and diverse opportunities have shaped me into the person I am today. I am immensely grateful for the knowledge, skills, and memories I have gained during my time at GIKI. I believe the willingness of professors to help us, not only in the areas pertinent to their classes but also in our endeavors outside the classroom, makes me proud of the choice I have made. This support extends beyond academic boundaries and demonstrates a commitment to our holistic development as individuals. The solid foundation I have acquired here will undoubtedly shape my future endeavors and enable me to contribute meaningfully to my chosen field.

Nayab khan - MS Students (Applied Mathematics)

After my BS in Mechanical Engineering, I found myself inclined towards pursuing masters. And in masters particularly I found my interests in Robotics and Controls. I searched for opportunities throughout Pakistan and find out GIKI to be best option for me to pursue my goal. After getting admitted to GIKI I found the working environment really good. Staff and faculty is very professional, co-operative and have expertise in their fields. The research facilities are up to notch with edge of having access to labs and machines 24/7 with no restriction, you can use your potential to its max.

Saad ur Rehman (gme2221)

I'm Sareer Ahmad from Swabi, and I earned my B.S. degree at UET Peshawar. With six months of internship experience, I embarked on an extraordinary journey when I was granted the opportunity to become a Graduate Assistant MS student at the prestigious Ghulam Ishaq Khan Institute of Engineering Sciences and Technology (GIKI). My experience at GIKI has been nothing short of transformative, characterized by an environment that fosters academic excellence, innovation, and personal growth. The institute's commitment to cutting-edge research, state-of-the-art facilities, Industry connections, and a dedicated faculty has enriched my learning experience. GIKI is not just an educational institution; it's a vibrant community that inspires and nurtures the leaders of tomorrow. As a current MS student at GIKI, I am excited about the endless prospects and the positive atmosphere that GIKI offers.

Sareer Ahmad, MS Student, Civil Engineering

I'm Izhar Ahmed and my experience as a graduate student at Ghulam Ishaq Institute of Engineering Sciences and Technology (GIKI) in the Department of Civil Engineering has been truly enriching. GIKI is renowned in Pakistan for its unwavering commitment to research and education. As a current postgraduate student, GIKI has proven to be an academic hub of excellence, equipped with top-tier research facilities, distinguished faculty, and collaborative research groups. Notably, GIKI's international partnerships connect us to leading researchers and laboratories worldwide, broadening our academic horizons. GIKI fosters self-driven, impactful students within a supportive, residential campus environment. Studying for my MS degree in the Civil Engineering Department, I've had the privilege of learning from experienced faculty who have significantly contributed to my academic journey. GIKI has been an unforgettable chapter in my academic and personal growth, offering knowledge, lifelong friendships, and a launch pad for a promising career.

Izhar Ahmed, MS Student, Civil Engineering

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HOW TO GET TO GIK INSTITUTE

- The Institute is less than one and half hour drive from Islamabad and Peshawar.
- Starting from Islamabad, exiting Islamabad-Peshawar Motorway M1(Point C) at Ghazi Interchange, follow road towords Tarbela and reach Campus after passing through Ghazi Barrage.
- Starting from Peshawar, you should follow the Motorway M1 (Point A) till you reach Swabi Interchange. From there come to Topi and the campus via Swabi.

DISCLAIMER

While every effort has been made to ensure the accuracy of the information in this Prospectus, the Institute can accept no responsibility for any errors or omissions. The Institute reserves the right to amend, offer delete or discontinue course(s) or amend admission requirement whenever it sees fit and prospective and registered students should enquire as to the up to date position should they need to know. The Institute takes all reasonable steps to provide educational ser vices in the manner set out in the Prospectus and in other documents that will be issued to you if you are accepted as a student of the Institute. Should certain circumstances beyond the control of the Institute interfere with its ability to provide educational services, the Institute will take all reasonable steps to minimise the resultant disruption to educational services.

Should you become a student of the Institute, this notice shall be incorporated as a term of any contract between you and the Institute. Any offer of a place at the Institute is made on the basis that in accepting such an offer, you signify your consent to compliance with registration proce dures, to observance of the Act, Guidelines, Rules and Regulations of the Institute.

For further information & updates, please contact or visit website:

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