



GHULAM ISHAQ KHAN INSTITUTE OF ENGINEERING SCIENCES AND TECHNOLOGY

GRADUATE PROSPECTUS 2018





VISION

The Institute aspires for the leadership role in pursuit of excellence in engineering, sciences and technology.

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 is as dear to me as a child to his parents. It gives me pleasure to see that the sapling we planted in 1993 is now a flowering tree providing its cool shade to seekers of knowledge."

Ghulam Ishaq Khan

From the Rector



The graduate program of the Institute was started in 2001 and has grown rapidly since then. The objectives are to nurture and sustain an indigenous tradition of quality research relevant to national and local needs, and to develop the infrastructure necessary for it.

The strength of this program is the highly qualified and experienced faculty from, apart from Pakistan, several countries, including USA, UK and Central Asia, and the extensive and sophisticated research facilities, comparable to those available in the universities of developed countries. The graduate program of the Institute has already produced about 367 MS and 61 PhD graduates in diverse fields such as computer science, computer engineering, mechanical engineering, electronic engineering, materials engineering and engineering sciences. Academic alliances, particularly research and student exchanges,

have been developed with leading foreign universities, including Turkey, China and South Africa. Faculty continues to win a large number of (competitive) research grants from various sources. Laboratories and curricula are upgraded regularly. An agreement was signed with Huawei, the Chinese multinational, for the company to establish a training center on campus: HAINA (Huawei Authorized Information and Network Academy). The Institute was, yet again, ranked as the number one private sector engineering university in Pakistan by the Higher Education Commission (HEC), and number three overall.

The Institute was one of only two in the country that was selected for assessment by three foreign experts in November 2017 for the purpose of Pakistan's accession to the Washington Accord. I am happy to say that Pakistan has very recently been accepted as a "Full Signatory" Member of the Accord, which would result in the recognition of Pakistani undergraduate engineering degrees by all the other member states. Credit for this goes to the Pakistan Engineering Council, but the Institute is extremely proud of its very significant role in this major achievement.

A unique feature of GIK is that all students, boys and girls, and foreign and Pakistani faculty members, live on its attractive, self-contained campus, which facilitates close student-teacher interaction, as well as amongst the students themselves. There is, thus, a very conducive environment for research. While the emphasis is on academics, students have an opportunity to participate in a range of activities outside the classroom, which is essential to an all-round education and personality development. Apart from the excellent sports facilities, there are close to thirty students' societies: from art to aeromodelling; from mathematics to media. Students are encouraged and facilitated to participate in national and international competitions and other events, and many have been coming back with awards and commendations.

I thank you for choosing GIK as a possible destination for your further education. I wish you the best in this endeavor.

Jehangir Bashar

From the Pro-Rector (Academics)

Since its inception the GIK Institute has a reputation as one of the country's finest institute for research and technological development. With each passing year the Institute graduate programme has further strengthened offering Master's and PhD Degrees in a number of emerging areas across the available faculties and programs. With an array of laboratories and research facilities the Institute endeavors to prepare graduate students for challenges in industries, academia or research organizations.

The core of the GIK Institute mission is to provide excellent teaching and research environment to produce graduates who distinguish themselves by their professional competence, research, pragmatic approach to problem solving and ability to respond to the challenge of socio-economic development. This is realized by providing graduate students an intellectually stimulating and conducive research environment, well-resourced library, state-of-the-art research facilities, fully supported by a dedicated and a research active faculty members. No wonder our graduate students are highly sought after who have longstanding history of contributing to academia, industries and research organizations nationally and internationally. Furthering your education at the GIK Institute will provide you with an opportunity to work with faculty members who are outstanding leaders in their fields of teaching, research and scholarship.

GIK Institute offers graduate program in the field of engineering, natural sciences and management sciences. The Graduate Program of the Institute is designed to help students in attaining a high level of scholarship. The graduate programme is distinctive in a way that various faculties and departments have the freedom to tailor graduate programme as per their requirements. Moreover cross faculty collaboration and multi-disciplinary research themes are not only encouraged but also supported. The students are thereby assisted in developing new skill sets as well as the skills of assimilation, analysis, evaluation, and application of knowledge. Such scholarship increases the student's breadth and depth of knowledge and prepares them for roles of leadership and participation in the areas of sociocultural and technological basis for the development of society, consistent with Institute mission. The Graduate Program permits the student to specialize but at the same time to have a broad educational base. The Graduate Program helps students develop skills to carry out these processes. The Graduate Program may provide you with the opportunity to acquire an educational background broader than your specialty. However, the primary aims of the GIK Institute Graduate School are to prepare you to use the disciplinary techniques necessary for the creation of new knowledge and to assist you in embarking upon research in specialized fields.

But life is not all study and research, and when you are ready to take a break, you will find that GIK Institute is the ideal place as it offers a wide variety of social, cultural and sports facilities which not only provide the much needed relaxation and enjoyment to the students but also inculcate in them the qualities of creativity, cooperation and team spirit.



Prof. Dr. Jameel-Un Nabi, FInstP

From the Pro-Rector (Administration & Finance)



Graduate studies is directly related to the strength of a University, as producing original research is its significant component. GIK Institute likewise gives a higher importance to graduate studies with a mandate to promote, advance and foster excellence in graduate education and university research. Expressing my pleasure to welcome you as graduate students, let me say that I take pride to support the Institute's endeavors to promote research which requires activities including but not limited to regulate and process the funding requirement for research work; completion of research projects; timely sanction of stipends to the Graduate Research Assistants; making arrangements for the offices and residences of graduate students; provision of civil amenities and similar other services each of which poses a challenge within itself. These challenges are met by the Administration & Finance with 6 Departments 5 of which are presently headed by Directors viz Director (Finance), Director (Facilitation), Director (Procurement), Director

(Projects/Maintenance) and Director (Security & Protocol) working under my supervision while the sixth, the Human Resource Department presently directly looked after by me through Assistant Director (HR). The Departments endeavor to work in close coordination with faculties and related departments, providing proactive administrative, financial, security and logistic support for all the activities of the Institute.

Managing the human and economic resources of the Institute within the overall ambit of financial discipline, procurement of supplies, improving and maintaining horticultural beauty of the campus, meeting the transport and security needs fall within their scope. In addition to the six Departments, Medical Centre works round the clock to take care of the health and medical requirements of the students, the faculty and the employees providing free medicines and free of charge laboratory investigations. It is thus one place to which you, as a graduate student, will stay connected to during your stay at the Institute. I take pride in the role which Administration and Finance play in this Institute, striving for academic excellence, meeting both the needs of the academic faculties and students. All the best for the test and looking forward to seeing you becoming a part of the unique Campus having a life style of its own kind and carrying the title of Gikian for the rest of your life.

Ahsan Basir Sheikh

From the Dean, Graduate Studies

Welcome to the graduate program at Ghulam Ishaq Khan Institute of Engineering Sciences and Technology, where synergies from outstanding students, world-class teaching, and research converge to produce the next generation of thought leaders in academia and across a multitude of industries that will chart our national and global futures.

From a very humble beginning in 2001, the graduate program has so far successfully produced several hundred Masters and PhD graduates who are working across academia and industry both at national and international horizon. Working intimately across faculties and with other institutions, our students experience excellence in graduate education and student success while assuring a culture of integrity and pledging a commitment to diversity in all its forms. The Institute has established several active linkages with institutes around the globe including the USA, South Africa, China and Turkey, among many others. With a fully residential campus, our students find it convenient to access their research labs or meet with their advisors even during late hours.

The graduate office at the GIK Institute is responsible for three major activities:

1. Looking after the graduate students and advocating on their behalf at every level of university administration.
2. Assuring the quality, excellence, and competitiveness of our PhD and Masters programs across the university (from admissions policies and procedures to the quality and caliber of our curricula and theses).
3. Funding our graduate students and supporting them in their academic and career goals.

Whether you are a prospective student or already headed to GIK Institute for graduate studies, I invite you to explore our programs and visit our beautiful campus if you can. In case you have any queries or require any further assistance, please do not hesitate to contact the graduate office.



Prof. Dr. Ghulam Shabbir

CONTENTS

Campus Life

Genesis	8
Aims and Objectives	9
Board of Governors	10
International Advisory Board	11
Campus	13
Clubs and Societies	15
Library and Information Services	20

Academics

The Graduate Program	22
Eligibility	23
Fees and Expenses	24
Graduate Assistantships	24
Organization	27
Rules and Regulations	28
Master's Degree Program	28
Doctoral Degree Program	29

Faculties

Faculty of Computer Science and Engineering	33
Faculty of Electrical Engineering	53
Faculty of Engineering Sciences	65
Faculty of Materials and Chemical Engineering	79
• Department of Materials Science and Engineering	83
• Department of Chemical Engineering	94
Faculty of Mechanical Engineering	101
Department of Management Sciences	115
• Engineering Management Program	117
• Master of Business Administration	122
Energy Systems Engineering (Interfaculty Program)	145

Lab Facilities and Research Groups	153
Faculty for Graduate Program	173
Graduate Alumni	182
Graduate Students	185
Important Contacts	189
How to Reach GIK Institute	190



Campus Life



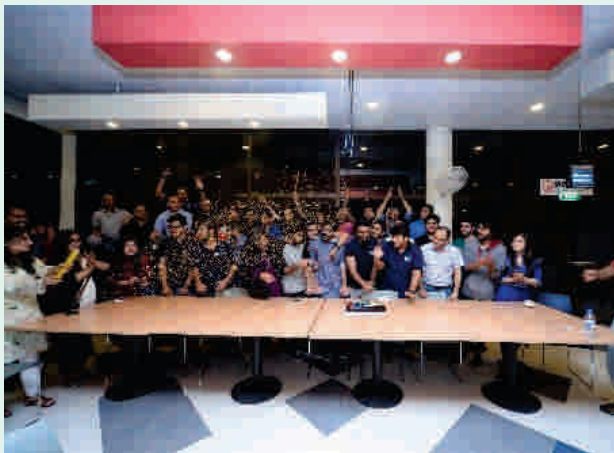
GENESIS

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 Kyber 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 in Pakistan (SOPREST). 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.



BOARD OF GOVERNORS

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. Shams ul Mulk, HI, Ph.D. (Hon), D.Sc. (Hon)

Founding Members

Engr. Shah Nawaz Khan

Engr. Salim Saifullah Khan

Dr. Ishfaq Ahmad, NI, HI, SI

Mr. Yusuf H. Shirazi / Mr. Ali H. Shirazi

Mr. M. Adil Khattak

Mr. Farid Rahman

Mr. Khwaja Zaheer Ahmad

Mr. Atif Rais Khan

Mr. Osman Saifullah Khan

Other Members

Mr. Abdul Razzaq Dawood

Mr. Shah Faisal Afridi

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 Pakhtunkhawa

Secretary Law, Khyber Pakhtunkhawa

Secretary SOPREST and BOG

Mr. Mushtaq Ahmed



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 maintain the Institute's standards of education and research. One such device is the International Advisory Board consisting of leading 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, the caliber of faculty, revision and review of the curricula, and the adequacy of the laboratory and library facilities. It also reviews the development programs of the Institute and provides guidelines for its growth in the future.

The present Advisory Board comprises the following members for each faculty:

FACULTY OF MATERIALS AND CHEMICAL ENGINEERING (FMCE)

1. Prof. Dr. John H. Weaver

Donald B. Willett Professor
Department of Materials Science & Engineering and
Department of Physics, University of Illinois at
Urbana-Champaign, USA

2. Dr. Manfred Roth

Head Joining and Interface Technology
Swiss Institute of Technology (EMPA), Dübendorf,
Switzerland

3. Prof. Dr. Shuichi Miyazaki

Institute of Materials Science, University of
Tsukuba, Tsukuba, Ibaraki 305-8573, Japan

FACULTY OF MECHANICAL ENGINEERING (FME)

**1. Prof. Dr. David H Nash, FIMechE FIES ASME
Fellow CEng**

Reader & Vice Dean (Knowledge Exchange)
Faculty of Engineering, Department of Mechanical



and Aerospace Engineering
University of Strathclyde, 75 Montrose Street,
Glasgow, G1 1XJ, UK

2. Dr. Zahid Ayub

President Isotherm, Inc (a Manufacture of Heat Transfer Equipment), 7401 Commercial Blvd, East Arlington, Texas 76001, USA

3. Dr. Ahmed F. Ghoniem

Ronald C. Crane (1972) Professor of Mechanical Engineering, Massachusetts Institute of Technology, 77 Massachusetts Avenue Cambridge MA 02139-4307, USA

FACULTY OF COMPUTER SCIENCE AND ENGINEERING (FCSE)

1. Prof. Dr. Ashfaq A. Khokhar

Departments of Electrical and Computer Engineering
University of Illinois, USA. Chicago, IL 60607

2. Prof. Dr. Eric Gaussier

University of Grenoble, B113, France

3. Professor Marcel Waldvogel

Department of Computer and Information Science
University of Konstanz, 78457 Konstanz Germany

FACULTY OF ELECTRICAL ENGINEERING (FEE)

1. Dr. Kamran Iqbal

Department of Systems Engineering
University of Arkansas at Little Rock , 2801 S.
University Ave, EIT 526
Little Rock, AR 72204-1099, USA

2. Dr. Costas Constantinou

Reader in Communications Engineering
School of Electronic Electrical and Computer
Engineering, University of Birmingham, Edgbaston.
Birmingham, B15 2TT, UK

3. Dr. Muhammad Suhail Zubair

Department of Physics, Texas A&M University
College Station, TX 77843-4242, USA

FACULTY OF ENGINEERING SCIENCES (FES)

1. Prof. Dr. Talat S. Rahman

Department of Physics, College of Sciences,
University of Central Floreda, Orlando USA

2. Prof. Dr. Sabin Stoica

Horia Hulubei National Institute of Physics and
Nuclear Engineering (IFIN-HH), Bucharest-Magurele,
Romania

3. Prof. Dr. Joseph D. Smith

Wayne and Gayle Laufer Endowed Energy Chair
Missouri University of Science and Technology
134 Sehrenk Hall, Rolla, MO 65409, USA

DEPARTMENT OF MANAGEMENT SCIENCES

1. Dr. John Gowdy

Rittenhouse Teaching Professor of Humanities and
Social Sciences, Department of Economics,
Rensselaer Polytechnic Institute 3208 Sage Hall
Troy, New York 12180, USA

2. Professor Kaifeng Yang

Administration and Policy College of Social
Sciences and Public Policy Bellamy Building 0656
Florida State University Tallahassee, Florida 32306-
2250, USA

DEPARTMENT OF CHEMICAL ENGINEERING

1. Prof. Dr. Jean-Francis Bloch

LGP2/ Grenoble INP-Pagora/CNRS
Physique des structures fibreuses, 461 rue de la
Papeterie - CS 10065 - 38402 Saint-Martin
d'Hères Cedex, France

2. Professor Marco Vanni

Department of Applied Sciences and technology
(DISAT), Politecnico di Torino, Italy

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.

Academic Facilities:

The entire campus is purpose-built and presents an environment most conducive to academic pursuits. The faculty buildings provide air-conditioned comfort and ample facilities like faculty offices, conference rooms, self-access centers and internet connectivity. The Institute has its own LAN connecting all faculties and students hostels. Advanced computing facilities are also available. These facilities vary according to their specialized requirements of the labs, including high performance dual processor machines, and special purpose CAD/ CAM and graphic computers. These computers are on different platforms with UNIX, LINUX and other latest Windows operating systems and speed ranges up to 3.2 GHz.

There are spacious lecture rooms with the provision of



audio-visual teaching aids and world-class laboratories and workshops with most modern equipment and machinery to facilitate the high quality teaching and research. The central library stocks a large number of books, magazines and journals that provides online access to books and ISI-indexed journals in other libraries. The auditorium, with the seating capacity of 535, is the venue of the conferences, seminars, debates, declamation and elocution contests, dramas, concerts and other academic and social functions. A fully equipped conference room, a VIP room, a cafeteria, a service



center and a printing press are also part of this block.

Sports Facilities:

The sports complex, located in close proximity of the student hostels, consists of a covered swimming pool, three squash courts and a gymnasium besides basketball, volleyball, tennis and badminton courts. Grounds for football, hockey and cricket are also available.

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. A well-equipped medical center provides round the clock health care to students, employees and their dependant family members. Guest house and parents lodge provide to the visitors and parents the facility of short stay at campus. The utility services like post office, campus restaurant, general store, stationery shop, fruit and vegetable shop, a barber shop, and dry cleaning and laundry services are available at campus. A Habib Bank branch provides banking facilities to students and employees of the Institute. The bank has also the facility of foreign currency accounts and lockers.



Faculty club and ladies club cater to the entertainment needs of the members. There are three beautiful mosques on the campus, one of which is in residential area and others near the hostels. Transport section of the Institute provides pick and drop facility to the students and staff from Rawalpindi/Islamabad and Peshawar on weekends, mid and end of semester breaks, industrial tours, and picnics.

Student Accommodation:

Being a fully residential campus all students live on campus. There is a small graduate hostel on campus. In addition, graduate students are given rooms in flats and in some undergraduate hostels.

Faculty and Staff Residences:

Most of the faculty and staff of the Institute are accommodated in independent houses and flats on the campus.

GIKI School:

A higher secondary school affiliated with the Federal Board of Intermediate and Secondary Education, caters to the needs of the children of the employees of the Institute.



CLUBS AND SOCIETIES

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 rigours of very demanding academic engagements. Each society is assisted by a faculty advisor. The sports society is facilitated by a full time sports officer. Some of the clubs and societies, which organize the socio-cultural activities, are introduced here.

Professional Societies

Each faculty in the Institute supports a professional organization, devoted to advancing theory and practice of their respective fields. IEEE and IEE represent the Faculty of Electronic Engineering whereas ACM is mainly represented by the students of Faculty of Computer Sciences and Engineering. ASM is a joint venture of the staff and students of the Faculty

of Materials and Chemical Engineering. The SPIE and Science Society works under the umbrella of Faculty of Engineering Sciences and welcomes the membership from all the faculties. ASME and AIAA student chapter are affiliated with Faculty of Mechanical Engineering.

These societies represent the GIKI Chapter of world wide associations, organize conferences and workshops, and are involved in activities ranging from helping students in their studies to arranging trips to industries. They are also an excellent platform to nurture the technical and scientific talents by encouraging and backing the projects undertaken by students on their own initiative.

NON-PROFESSIONAL SOCIETIES

Literary and Debating Society (LDS)

This 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 discussions 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 organises and participates in international events.

Cultural, Dramatic & Entertainment Society (CDES)

This society, one of the most active and widely applauded, adds colour to the campus life. It creates an entertaining and healthy diversion throughout the year by organizing musical concerts, drama festivals, skits competitions, picnics, bonfires, trips to historical sites and by arranging a big-screen movie show every fortnight. The activities of the society help in identifying artistic talents and nourish and foster these in students. The society also celebrates the much popular "Basant Festival" every spring.

Horizon Publication Society

'Horizon' is a publication society of the GIK Institute. The main aim of the society is to create awareness of the various social, political, educational and technical issues that concern the GIKI community. It is also committed to provide this community with a platform for expression on topics of common interest. Its major publications include Horizon (the main issue), Focus (a



higher education and career guidebook) and various supplements on activities in GIKI.

Naqsh

NAQSH Art Society is yet 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 foster artistic touch among the perspective engineers.

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 exposed to compiling and composing of newsletters / magazine. 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.

Sports Society

Sports Society comprises 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 and football fields, and basketball, volleyball and tennis courts. 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 perspective sportsmen to take part in various national sports events. Similarly, the Sports Society manages an "Adventure Club" which is affiliated with the Adventure Foundation of Pakistan. Moreover, it has recently been affiliated with the prestigious Alpine Club of Pakistan. The club organizes expeditions to nearby hill stations like Srikot, Swat, Abbottabad, etc. The Tarbela lake which is in close proximity of the Institute, provides ideal and natural environment for sailing. Students of the Institute have formed a sailing club which is affiliated with the Sailing Association Islamabad and is looked after by the Sports Society. The Club not only arranges to impart instructions on



sailing but also organizes periodically sailing and rowing competitions.

Women Engineers Society (WES)

The Women Engineers 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. 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 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. WES is currently working on organizing the third national symposium to discuss women related issues in the field of engineering and sciences.

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, woman/men empowerment, micro-financing, and continual support of some very poor families.

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 also functional in the Institute:-

- 1. GMS:** GIKI Mathematics Society
- 2. WES:** Women Engineers Society
- 3. SPIE:** International Society for Photo-optical Instrumentation Engineers
- 4. Science Society:** Science Society
- 5. IET:** Institute of Engineering and Technology
- 6. GIKI Sports Society:** GIKI Sports Society
- 7. IEEE:** Institute of Electrical and Electronic Engineers
- 8. Media Club:** Media Club
- 9. AIAA:** American Institute of Aeronautics and Astronautics
- 10. ASME:** American Society of Mechanical Engineers



- 11. Project Topi:** Project Topi
- 12. ASHRAE:** American Society of Heating, Refrigerating and Air Conditioning Engineers
- 13. SMEP:** Society of Mechanical Engineers of Pakistan
- 14. NAQSH:** NAQSH
- 15. ACM:** Association for Computing Machinery
- 16. CDES:** Cultural Dramatics & Entertainment Society
- 17. Netronix:** Netronix
- 18. Web team:** Web Team
- 19. LDS:** Literary and Debating Society
- 20. ASM/TMS:** The Mineral, Metal & Material Society/American Society of Materials
- 21. SOPHEP:** Society for the Promotion of Higher Education in Pakistan
- 22. AIESEC:** Association Internationale des Etudiants en Sciences Economiques et Commercial

- 23. IMechE:** Institute of Mechanical Engineers
- 24. AIChE:** American Institute of Chemical Engineers
- 25. CBS:** Character Building Society

Ladies Club

With the formation of a Ladies Club, a warm and friendly atmosphere has been created for ladies on the campus. The picturesque surrounding of the Institute and the close proximity of Tarbela Dam offers tempting avenues for study of nature and relaxation and the Club arranges frequent visits to the scenic spots of the area. The Club provides the Campus housewives with opportunities for socializing and filling their leisure with recreational activities. It holds regular classes for Dars-e-Quran, physical fitness and lectures in health care. National functions and Eid Milan parties are also celebrated and sporting contests are arranged for children.



LIBRARY AND INFORMATION SERVICES

A stately three-storey 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 inter-library loan and exchange of databases, it is electronically linked to all prominent libraries of the country. It also provides re-prographic 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, Science-Direct (partial) and other valuable resources.

Wireless network is available in the library and open for all users.

Student society Meeting/Discussion Room available in library on request.

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



ACADEMICS



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

- Chemical Engineering
- Computer Engineering
- Computer Science
- Electronic Engineering
- Engineering Sciences
- Mechanical Engineering
- Materials Engineering
- Nanotechnology and Materials Engineering
- Energy Systems Engineering
- Engineering Management
- Master of Business Administration (MBA)

PhD Degree Programs

- Chemical Engineering
- Computer Engineering
- Computer Science
- Electronic Engineering
- Engineering Sciences
- Materials Engineering
- 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 limit for the applicants. The Institute is guided by the following principle:

"The Institute is open to all persons on merits 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.
- Candidates have to pass the GIK Institute Graduate Admission Test (similar to GRE subject type) and Interviews. (those applicants who have minimum 50% cumulative score in NTS GAT-Subject/GRE-Subject Test are exempted from the Institute's admission test)

PhD degree program

- Applicants with minimum CGPA of 3.00 or above at MS/M.Phil and overall 60% marks throughout the academic career.
- Candidates have to pass the GIK Institute Graduate Admission Test (similar to GRE subject type) and Interviews. (those applicants who have minimum 60% cumulative score in NTS GAT-Subject/GRE-

Subject Test are exempted from the Institute's admission test). * HEC conditions apply

WRITTEN TEST /INTERVIEW

Written test (similar to GRE General and Subject types) and interview are conducted by the Institute.

The filled in 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.

- Complete the online application form.
- Filled in admit card.
- Three letters of recommendation signed by the referees who are qualified to vouch for the applicant's academic record and performance.
- Attested copies of degrees and certificates along with Official transcripts/DMC of all undergraduate and graduate work completed.
- Copy of NTS GAT-Subject / GRE-Subject Result Card (if any).
- Attested copy of CNIC/Passport
- Recent passport size color photographs.



- 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.
- Original receipt of non-refundable application processing fee.

TRANSFER WITH ADVANCED STANDING

A maximum of 9 credit hours of graduate course work at a PEC accredited and HEC recognized Institution may be transferred with the recommendation of the faculty, provided that:

- The course work fits into a logical program for the degree.
- A minimum of grade B has been earned.
- The transfer is approved by the office of graduate studies.

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 (GAO) or the campus website www.giki.edu.pk.

The tuition fee is payable before the commencement of the fall semester each year. A non-refundable admission fee (check with GAO) is also required to be deposited along with the annual tuition fee. Another amount (check with GAO) 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

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 or 75% 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 or 75% 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 or 75% 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 select 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
F	Failure
I	Incomplete
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 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 oversees 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

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 three categories of graduate students:

- A. GIK Institute sponsored students (usually called Graduate Assistants)
- B. Students sponsored by HEC and other organizations or self-financed.
- C. Students partially funded by GIK Institute



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.

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 Masters 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 has to 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 for MS Thesis Defense

During the week thirteen of a semester a student through his/her advisor submits the request for the thesis defense. The student provides 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 graduate at the current convocation 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

Program

A PhD student is required to choose his/her academic advisor during the first month of his/her 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 has to 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. One of the papers should be an IF (impact factor)-based and ISI-indexed.

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 has to 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 qualifying examination. The qualifying examination is taken at the end of two semesters' 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 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 graduate at the current convocation 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 three course 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

THRUST AREAS

Artificial Intelligence and Scientific Computing
Algorithms and Computational Theory
Machine Learning & Data Mining
Network Communications and High Performance
Computing
Signal and Image Processing, and Computer Vision
Software and Systems Engineering



Faculty

Khalid J. Siddiqui, Dean PhD (Concordia University, Montreal, Canada)

Computer Engineering

Masroor Hussain PhD (G.I.K. Institute, Pakistan)
Ahmar Rashid PhD (Jeju National University, South Korea)
Asif Khan PhD (University of Klagenfurt, Austria and QMUL, UK)
Shahabuddin Ansari PhD (G.I.K. Institute, Pakistan)
Sajid Anwar PhD (Seoul National University, South Korea)

Computer Science

Zahid Halim PhD (National University of Computer and Emerging Sciences, Pakistan)
S. Fawad Hussain PhD (University of Grenoble, France)
Ghulam Abbas PhD (University of Liverpool, UK)
Rashad Jillani PhD (Florida Atlantic University, USA)

Personal Assistant

Hamid Ur Rahman



Dean

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 (Ph.D.) 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 Faculty of Computer Science & Engineering (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 Master's (MS) and Doctor of Philosophy (PhD) degrees in Computer Science and Computer Engineering.

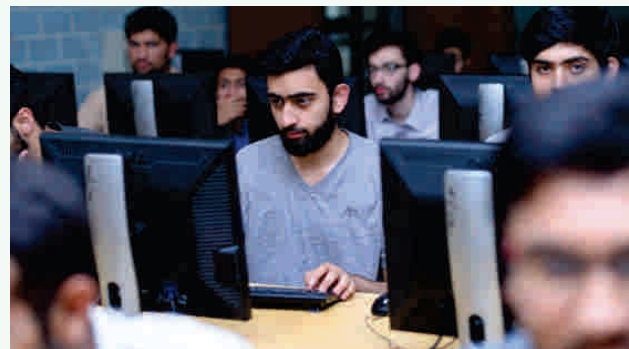
COURSE WORK:

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, & 2 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 eight courses, at least five 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

*Current list is available with the FCSE faculty.

Specialization Electives**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

Advance Topics

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
2nd Semester	
CSxxx/CExxx	Core - 2
CSxxx/CExxx	Elective - III
CSxxx/CExxx	Elective - IV
3rd Semester	
CSxxx/CExxx	Elective - V/ Core - 3
CSxxx*/CExxx*	Elective - VI/ Elective - V
CS599+/CE599+	Thesis - 1
4th Semester	
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	Core-1
CSE	Elective I
CSE	Elective II
2nd Semester	
CSE	Core-2
CSE	Elective III
CSE	Elective IV
3rd Semester	
CSE	Core-3
CSE	Elective - V
CSE	Thesis-I
4th Semester	
CSE	Thesis-II
5th Semester	
CSE	Thesis-III
6th Semester	
CSE	Thesis-IV



COURSE DESCRIPTION

CSE501 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

CSE503 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.

CSE504 Advanced Computer Architecture (3-0-3):

Von Neumann architecture instruction set 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.

CSE511 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.

CSE512 Compiler Construction(3-0-3):

Advance Theory/Classification of languages and grammars, Advanced theory of Computation, lexical analysis, deterministic, parsing techniques, symbol table processing, code generation, syntax directed compiling and global optimization.

CSE513 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

CSE514 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.

CSE517 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.

CSE518 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.

CSE520 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.



CSE521 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.

CSE522 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.

CSE523 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.



CSE524 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.

CSE525 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

CSE526 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.

CSE527 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 link-state 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.

CSE528 High Performance Networks (3-0-3): Topics 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.

CSE529 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,



CSE533 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.

CSE534 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.

CSE535 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.

CSE538 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.

CSE539 Robotic Vision(3 0 3): Basic image processing techniques , feature detection, feature tracking, camera models, geometry and calibration, geometrical models of single, two, and multiple view systems, 2-D and 3-D vision, estimation of camera and object motion, visual odometry, OpenCV to implement real-time vision algorithms, robot operating system (ROS), simultaneous localization and mapping, motion planning for autonomous vehicles.

CSE541 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.

CSE542 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.

CSE543 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.

CSE546 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.

CSE551 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.

CSE552 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.

CSE553 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.

CSE554 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.

CSE561 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.

CSE562 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.

CSE563 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.

CSE564 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.

CSE565 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.

CSE571 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.

CSE572 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 extraction, machine translation.

CSE573 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.

CSE574 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.

CSE581 Advanced Digital Communication (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.



CSE633 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.

CSE637 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.

CSE660 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.

CSE661 Machine Learning and Computer Vision (3-0-3): Symbol based learning, connectionist learning, Bayesian learning; introduction to computer vision, motion analysis, biometric recognition, object detection, and other advanced topics of machine perception.



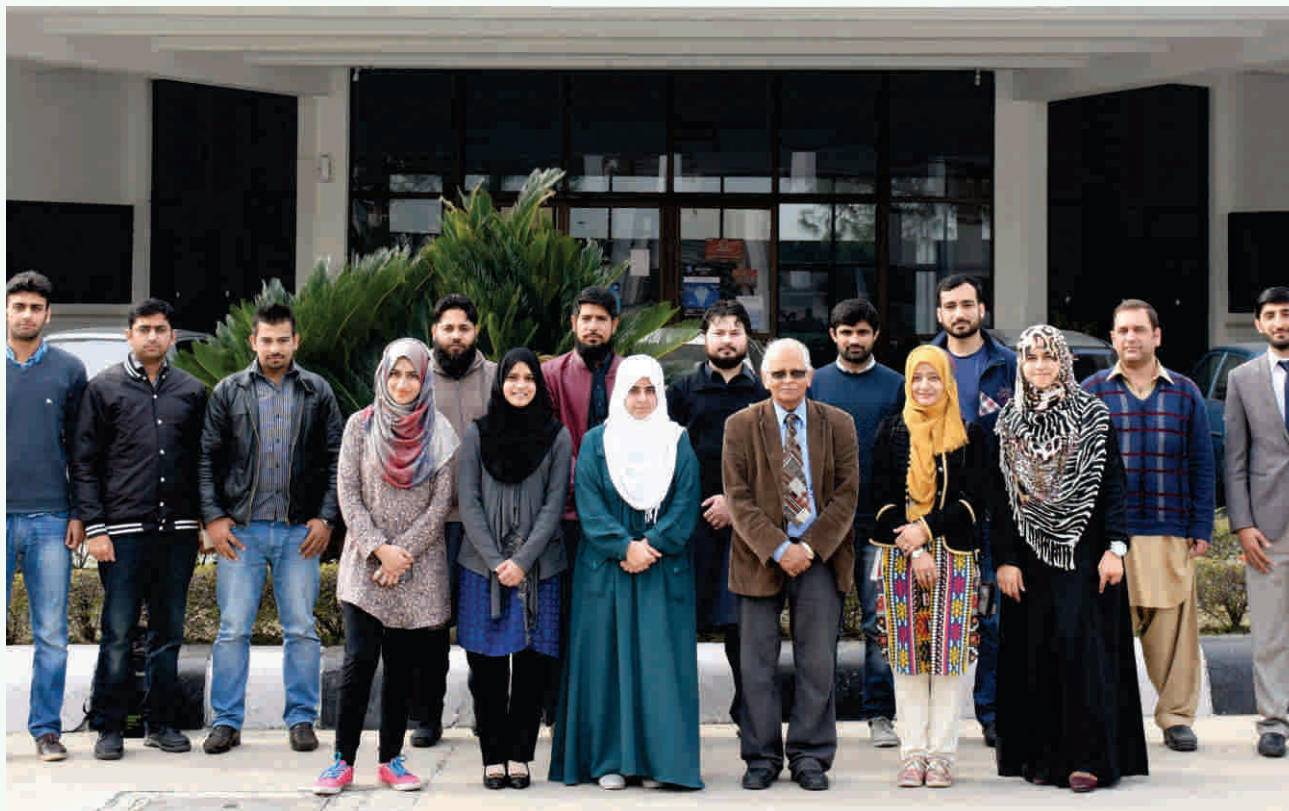
CSE681 Optical Computing (3-0-3): Basic theory of diffraction, lenses, the fast Fourier transform, optical memory, optical signal processing, computer-generated holograms; optical implementation of neural networks and other advance topics.

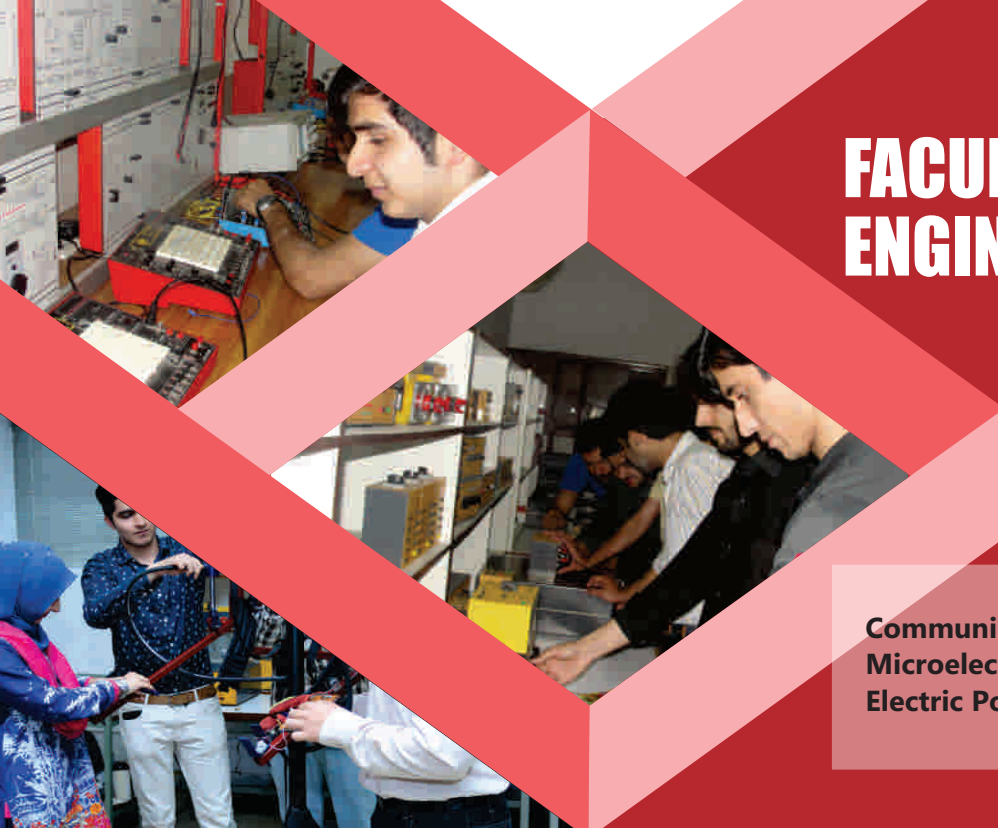
CSE590/690: Special Topics in Computer Science (3-0-3): The Computer Science program offers "Special topics," only occasionally on topics of current interest. The selection of a topic is different every semester. Special Topics courses do not repeat material presented by regular semester courses.

CSE591/691: 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.

CSE599 Master Thesis (6)

CSE699 Ph.D Dissertation (18)





FACULTY OF ELECTRICAL ENGINEERING

THRUST AREAS

Communication and Digital Signal Processing
Microelectronics and ASIC Design
Electric Power and Control Systems



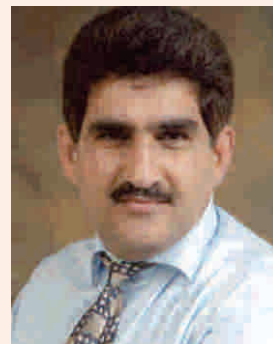
FACULTY OF ELECTRONIC ENGINEERING
AND FACULTY OF COMPUTER SCIENCE

Faculty

Nisar Ahmed, Dean	PhD (University of London, UK)
Khasan Karimov	PhD (S. Petersburg, Russia)
Muhammad Akbar	PhD (University of Tokyo, Japan)
Muhammad Amin	PhD (UET Taxila, Pakistan)
Zia-ul-Haq Abbas	PhD (University of Agder, Norway)
Adnan Noor	PhD (University of Manchester, UK)
Husnul Maab	PhD (QAU, Islamabad, Pak.)
Arbab Abdul Rahim	PhD (Politecnico di Torino, Italy)
Shahid Alam	PhD (Chalmers University, Sweden)
Muhammad Mahmood Ali	PhD (University of Malaya, Malaysia)
Hadeed Ahmed Sher	PhD (King Saud University, Kingdom of Saudi Arabia)
Ahmad Kamal Hassan	PhD (King Abdulaziz University, Kingdom of Saudi Arabia)
Muhammad Muqeet Rehman	PhD (Jeju National University, South Korea)

Personal Assistant

Ikram Ullah M.A.	(Gomal University, Pakistan.)
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Dean

The explosive growth in the area of electrical engineering during the past two decades has impacted almost every facade of human life. Developments in Digital Electronics, Signal Processing and Communications 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 any more 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.

Graduate program can be pursued in FEE with specialization in one of the following three areas:

- i. Microelectronics, MEMS and ASIC Design,
- ii. Power and Control System, and
- iii. Communication and Digital Signal Processing

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 eight courses, four must be from the list of FEE courses, and the remainder could be from other faculties.



LIST OF COURSES

CORE COURSES

EE501	Microwave Engineering
EE502	Linear Systems Theory
EE503	Stochastic Processes

AREA OF CONCENTRATION

Microelectronics and ASIC Design

EE521	Introduction to ASIC Design
EE522	VLSI Design
EE531	Semiconductor Device Processing and Technology
EE532	Microwave and Photonic Devices
EE571	MEMS Design and Micromachining
EE621	CISC Microprocessor System Design
EE632	Quantum Phenomena in Semiconductor
EE633	Organic Semiconductor & Devices

Communication and Digital Signal Processing

EE551	Digital Image Processing
EE552	Advanced Digital Signal Processing I
EE561	Advanced Digital Communications
EE562	Antennas Design and Applications
EE563	Information Theory
EE564	Performance Analysis of Computer and Communication Networks
EE601	High Frequency Electromagnetics
EE613	Electromagnetic Metamaterials
EE651	Remote Sensing
EE652	Digital Signal Processing II
EE653	Numerical Optimization
EE654	Multirate Systems and Filter Banks
EE655	Theory of Wavelet Transform and its Applications
EE656	Advanced Multirate Filter Bank Theory and Its Applications
EE661	Mobile Cellular Telecommunication Systems

Power and Control Systems

EE511	Transmission and Distribution of Electric Energy
EE512	Computational Methods for Power System Analysis
EE513	Power Converters, Design & Applications
EE514	Power Semiconductor Devices
EE515	Adjustable Speed Drives
EE516	Photovoltaic Energy and Its Applications
EE517	Electronics For Energy Control
EE541	Digital Control Systems
EE542	Nonlinear Control Systems
EE543	Optimal Control and Estimation
EE544	Intelligent Control Systems
EE545	Adaptive Control
EE611	Dynamic and Control of Integrated Power Systems
EE612	Optimization and Economics of Integrated Power Systems
EE641	Advanced Continuous Time Control Systems Design
EE642	Robust Control of Uncertain Systems
EE643	Advanced Process Control
EE644	Navigation Guidance and Control
EE645	Model Order Reduction for Large Scale Systems

Special Topics

EEXXX	Special Topics in Electrical Engineering
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COURSE DESCRIPTION

EE501 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).

EE502 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.

EE503 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; Gaussian processes.



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; field effects; 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 SITh, 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 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.

EE517 Electronics for Energy Control (3-0-3): Single- and three-phase converter; HVDC; FACTS; UPS; wind turbines; fuel cells; electric vehicles; variable speed drives; semiconductor devices used in power electronic systems; static converters for single- and three-phase rectification and inversion design; standby and portable AC supplies; AC transmission networks; dynamic voltage restorer applications; DC/DC converters for fuel cell and electric vehicle applications.

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.

EE521 Introduction to 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.

EE522 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 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.



EE531 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.

EE532 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.

EE541 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.

EE542 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 linearization; sliding control; variable structure control; adaptive control of linear and nonlinear systems; control of multi-input multi-out systems.

EE543 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.

EE544 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.



EE545 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.

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-Loeve 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; predictive 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.

EE562 Antennas 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.

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.

EE564 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.



EE571 MEMS Design and Micromachining (3-0-3):

MEMS devices; MEMS operating principle and applications; accelerometers/combdrive; RF switch; micromirror design and scaling issues; system level design using SPICE; 2D layout design; 3D modeling with process emulation; physical level simulation and analysis using ANSYS; micro machining / micro fabrication technologies; micro machining techniques; CMOS compatible bulk micro machining; surface micro machining; a surface micro machining technology PolyMUMPs will be studied with description of technology file development in L-Edit layout tool.

EE601 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 descent method; perturbation methods; basics of geometric theory of diffraction and uniform theory of diffraction.

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 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.

EE621 CISC Microprocessor System Design(3-0-3):

An overview of advanced architecture CISC/RISC microprocessors and their associated support; design techniques for advanced 32/64-bit CISC/RISC microprocessors and their associated support; memory management; floating point support; advanced peripherals; PLD-based "glue logic" design performance evaluation; IEEE standard open architecture system buses and various pertinent interface and networking standards.

EE632 Quantum Phenomena in Semiconductors (3-0-3):

Preliminary concepts; free electron theory; band theory of electronic conduction; semiconductors fundamentals; effective mass equation; transport and recombination of excess carriers; property of heterostructures; high field phenomena; optical properties.

EE633 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.

EE641 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.

EE642 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.

EE643 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.

EE644 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.

EE645 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.

EE651 Remote Sensing (3-0-3): Introduction to the 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 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.

EE655 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.

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.

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 noncochannel interference; frequency management; handoffs; operational techniques and technologies.

EE662 Special Topics in Electrical Engineering (3-0-3):

EE599 MS Thesis (6)

EE699 PhD Dissertations (18)





FACULTY OF ENGINEERING SCIENCES

THRUST AREAS

**Applied Mathematics
Applied Physics
Digital Systems Engineering and
Photonics Engineering**



**FACULTY OF
ENGINEERING SCIENCES**

Dean

Prof. Dr. Muhammad Hassan Sayyad
PhD (Dublin City University, Ireland)

Faculty

Jameel-Un Nabi,
Ghulam Shabbir,
Habibullah Jamal,
Sirajul Haq,
Irgaziev Bakhadir,
Tahseen Amin Khan Qasuria,
Dur-e-Zehra Baig,
Muhammad Usman,
Muhammad Zahir Iqbal,

Ph.D (University of Heidelberg, Germany)
PhD (University of Aberdeen, UK)
PhD (University of Toronto, Canada)
PhD (University of Liverpool, UK)
PhD (Moscow State University), D.SC. (Uzbekistan)
PhD (GIK Institute, Pakistan)
PhD (University of New South Wales, Australia)
PhD (Hanyang University, South Korea)
Ph.D (Universitat Politècnica de Catalunya, Spain) Post Doct. (Georgia State University, USA)

PS to Dean, FES

Muhammad Shafiq

MA English (University of Peshawar, Pakistan)



Dean

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:** (i) Digital Systems Engineering
(ii) Photonics Engineering

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.

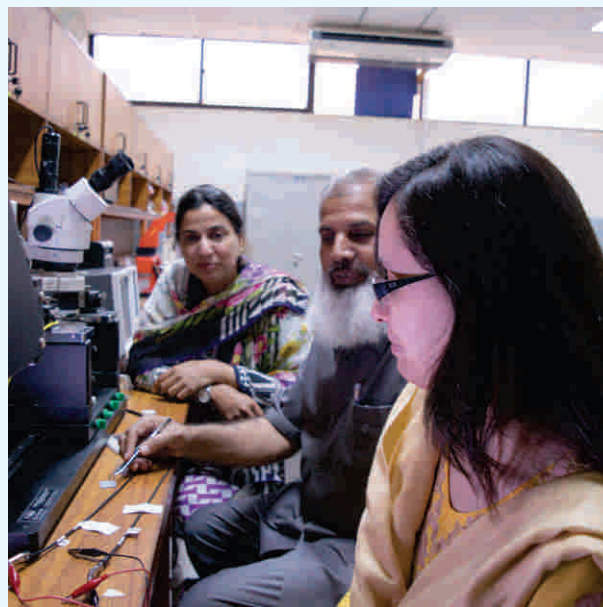
COURSE WORK:

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 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 eight courses, four must be related to his/her area of specialization.



LIST OF COURSES

CORE COURSES

ES512	Photonics
ES531	Computational Methods for Engineers
ES551	Digital Systems
ES569	Advanced Quantum Mechanics

ELECTIVE COURSES

Group A (Applied Mathematics)	
ES521	Advanced Transform Techniques
ES522	Advanced Fluid Mechanics
ES523	Special Relativity
ES524	General Relativity
ES526	Analytical Solution of Partial Differential Equations
ES527	Asymptotic Methods for Differential Equations
ES533	Numerical Methods for Partial Differential Equations
ES534	Numerical Functional Analysis
ES541	Variational Methods in Mechanics
ES542	Finite Element Methods for Engineers
ES543	Perturbation Methods
ES544	Random Processes
ES621	Advanced General Relativity
ES631	Numerical Methods in Ordinary Differential Equations
ES69X	Special Topics in Applied Mathematics
Group B (Applied Physics)	
ES511	Solid State Physics
ES514	Thin Films
ES515	Two-Dimensional Materials and Devices
ES516	Spintronic Devices
ES517	Quantum Devices
ES561	Fourier Optics
ES562	Organic Solar Cells: Materials and Device Physics

ES564	Astrophysics
ES566	Atomic & Molecular Spectroscopy
ES576	Organic Optoelectronics
ES577	Integrated Optics
ES581	Advanced Experimental Techniques
ES611	Advanced Nuclear Astrophysics
ES612	Computational Nuclear Physics
ES642	Organic Electroluminescence
ES69X	Special Topics in Applied Physics
Group C (Digital Systems Engineering and Photonics Engineering)	
ES513	Semiconductors
ES537	Reconfigurable Computing and FPGA Architecture
ES538	Design for Test and Testability
ES552	Biophotonics
ES553	Digital Signal Processing
ES554	Digital Control System
ES555	Adaptive Filtering
ES556	Advanced Computer Architecture
ES557	Digital Image Processing
ES558	Advanced Digital Signal Processing
ES559	Digital Communication
ES563	Laser Materials Processing
ES565	Photonics and Optical Communication
ES567	Photonic Devices
ES572	Principles of Laser Engineering
ES573	Optical Fibers and Applications
ES574	Applications of Lasers
ES579	Advanced Digital System Design
ES585	Photonics Networks
ES69X	Special Topics in Digital Systems Engineering
ES69X	Special Topics in Photonics Engineering

COURSE DESCRIPTION

ES511 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 Schrödinger wave equation, importance and physical significance of Schrödinger 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.

ES512 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.

ES513 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.

ES514 Thin Films (3-0-3): Deposition techniques, properties, characterization, structure, transport-phenomena and superconductivity in thin films, applications.

ES515 Two-Dimensional Materials and Devices (3-0-3): Introduction of two-dimensional (2D) layered materials i.e. graphene, hexagonal boron nitride and various transition metal dichalcogenides, device fabrication techniques for 2D materials and their van der Waals heterostructures, structural characterization and electrical transport of two-dimensional field effect transistors (FETs), carrier density and mobility calculations, Optoelectronic, gas, chemical and humidity sensing applications of 2D materials FETs, Two-dimensional layered heterostructures for memory devices.

ES516 Spintronic Devices (3-0-3): Introduction of spin electronics, principle of spintronic devices, selection of materials for spin devices including ferromagnets and interface materials, current-in-plane (CIP) and current perpendicular-to-plane (CPP) spin valve devices, magnetic tunnel junctions, types of magnetoresistance (MR): anisotropic magnetoresistance (AMR), giant magnetoresistance (GMR), colossal magnetoresistance (CMR) and tunneling magnetoresistance (TMR), applications of two-dimensional (2D) materials i.e. graphene, hexagonal boron nitride, 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.

ES517 Quantum Devices (3-0-3): Introduction of quantum electronics, principle of quantum devices, quantum Hall effect (QHE) and various types of quantum Hall system, weak localization (WL) and weak antilocalization (WAL) phenomena, intervalley and intravalley scattering mechanism, phase coherent transport, QHE in 2DEG systems, 2D layered materials and their heterostructures, carrier density and mobility calculations, temperature dependent WL, WAL and QHE phenomena, magneto-transport and remote sensing of microwave reflection in 2DEG systems and 2D layered materials under microwave excitation.

ES521 Advanced Transform Techniques (3-0-3): Integral transforms, Fourier, Laplace, Hankel and Mellin transformations and their applications, singular integral equations, Wiener-Hopf techniques, applications of conformal mapping, introduction to asymptotic expansions.

ES522 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.

ES523 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.

ES524 General Relativity (3-0-3): Manifolds, tensors, derivative operators and curvature, homogeneous, isotropic, cosmology, exact solutions of Schwarzschild, Minkowski, Desitter, anti-desitter, kerr, Robertson-Walker and Riessner-Nordström space times.

ES526 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.

ES527 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.

ES531 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,

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.

ES534 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.

ES537 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.

ES538 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 (Dalgorithm,



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.

ES541 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, Castigliano's theorem, and eigen values, the finite element method, general use of Lagrange multiplier.

ES542 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.

ES543 Perturbation Methods (3-0-3): Asymptotic sequences and series, asymptotic expansion of integral, solution of differential equations about regular and irregular singular points, nonlinear differential equations, perturbation methods, regular and singular perturbations, matched asymptotic expansions and boundary layer theory, multiple scales, WKB theory.

ES544 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.

ES551 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.

ES552 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.

ES553 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.

ES554 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.

ES555 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 deconvolution, analysis of performance and applications.

ES556 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.

ES557 Digital Image Processing (3-0-3):

Image sampling and quantization, color, point operations, segmentation, morphological image processing, linear image filtering and correlation, image transforms, eigen images, multi-resolution image processing, noise reduction and restoration, feature extraction and recognition tasks, image registration, Implementing and investigating image processing algorithms.

ES558 Advanced Digital Signal Processing (3-0-3):

Review of signal processing, coverage of signal processing methods and tools, implementation of algorithms, various applications.



ES559 Digital Communication (3-0-3): Review of digital baseband transmission and modulation techniques, source coding (e.g., digital compression), trellis coded modulation, digital signaling over fading multipath channels, spread spectrum signals for digital communications, multiple access systems, time-division multiple access, code-division multiple access, frequency-division multiple access, OFDM communications systems and digital communication applications.

ES561 Fourier Optics (3-0-3): Plane waves and spatial frequency, Fresnel and Fraunhofer 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.

ES562 Organic Solar Cells: Material and Device Physics (3-0-3): Introduction to organic solar cells, active layer materials for organic solar cells, bulk-heterojunction 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.



ES563 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

ES564 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.

ES565 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

ES566 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.

ES567 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. Photodetectors: 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.

ES569 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.

ES572 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.

ES573 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.

ES574 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.

ES575 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.

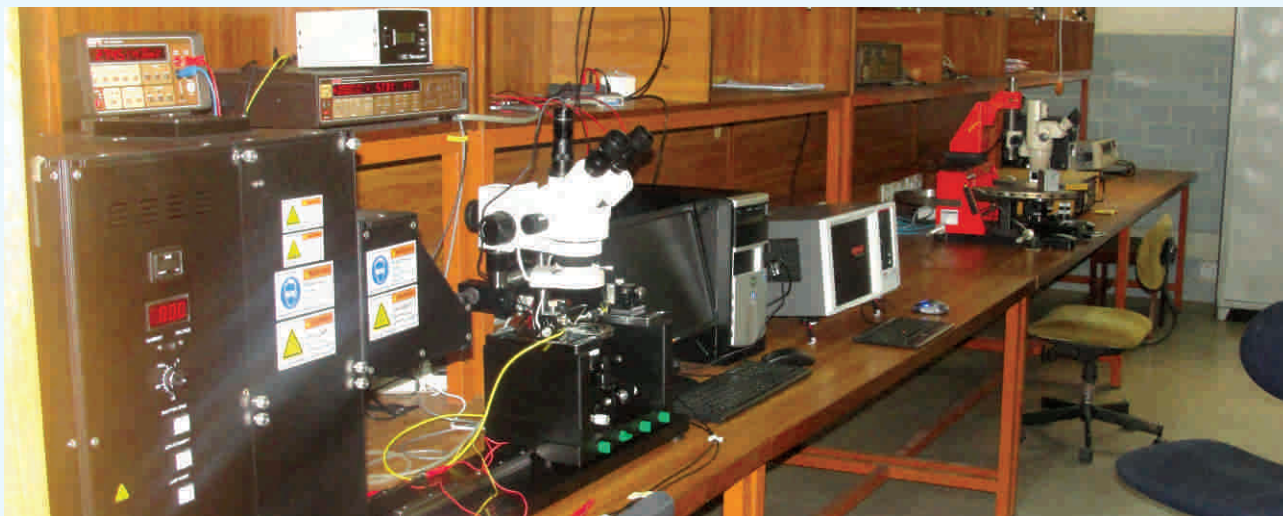
ES576 Organic Optoelectronics (3-0-3): Electronic processes in organic solids, organic photonic devices, organic photosensors, organic light-emitting diodes, organic lasers, organic optical amplifiers, organic solar cells based on small molecules, polymer solar cells, dye-sensitized solar cells (DSSCs).

ES577 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.

ES579 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.

ES581 Advanced Experimental Techniques (3-0-3): Different techniques of fabrication, characterization and analysis in the field of lasers, superconductors, radiation physics, fiber optics, optical materials and environmental sciences.

ES585: 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.

ES611 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.

ES612 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.

ES621 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.

ES631 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.

ES642 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 electroluminescent conjugated polymers, organic electrophosphorescence, past, present and future directions of organic electroluminescent displays, organic electroluminescent devices, photoexcited organic lasers.

ES69X: 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.

ES599 MS Thesis (6)

ES699 PhD Dissertation (18)





FACULTY OF MATERIALS AND CHEMICAL ENGINEERING

THRUST AREAS

Department of Materials Science and Engineering

Materials Processing, Manufacturing and Characterization, Biomaterials, Energy Materials
Surface Engineering and Coating Technology,
Nanotechnology and Nanomaterials, Ceramics,
Polymers and Composites, Computational Materials
Science, Corrosion and Oxidation

Department of Chemical Engineering

Process and Equipment Design,
Fluid Handling and Thermodynamics Behavior,
Reaction Kinetics and Catalysis,
Transport Processes



FACULTY OF
MATERIALS & CHEMICAL ENGINEERING

Faculty

Ashraf Ali, Dean PhD (University of Cambridge, UK)

Department of Materials Science and Engineering

Ashraf Ali, Dean PhD (University of Cambridge, UK)
 Fida Mohammad PhD (University of California, USA)
 Yasir Faheem Joya PhD (The University of Manchester, 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)



Dean

Department of Chemical Engineering

Javaid Rabbani Khan, HoD PhD (University of Newcastle upon Tyne, UK)
 M. Shozab Mehdi PhD (PIEAS, Pakistan)
 Khurram Imran Khan PhD (Politecnico di Torino, Italy)
 Sajjad Hussain PhD (University of Sao Paulo-USP, Brazil)
 Muhammad Usman Farooq PhD (University of Waterloo, Canada)
 Hammad Amjad Khan PhD (Hanyang University, South Korea)

Personal Assistant:

Mohajir Shah M.A (University of Peshawar), Pakistan



HoD

The world today demands innovative, sustainable and efficient use of materials, chemicals and processes both for advanced engineering applications and also for traditional products, by using improved production and processing methods. In-depth understanding is required for the development of smart materials for industrial technology particularly in emerging fields such as Nanotechnology, Biotechnology and Renewable Energy whereas a broader view is often required to adapt processes, techniques and materials for industrial competitiveness and the improvement of existing products. Materials and Chemical Engineering are fascinating discipline involved in building and sustaining the world around us as well as designing new materials for the future. They offer a unique combination of advanced knowledge and research methods for deeply enriching interdisciplinary experience maximising career opportunities for our graduates.

The Faculty of Materials and Chemical Engineering (FMCE) comprises of two departments:

- Department of Materials Science and Engineering (DMSE)
- 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.

The FMCE graduate programme aims to build on the engineering knowledge and research skills by offering advanced courses and specialized research projects by which the student can develop expertise in their chosen fields. If you are interested in converting raw materials into valuable products or are fascinated by altering the chemical or physical properties of a substance to design novel material, FMCE is the right place for you.

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 Program:

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

MS Degree:

The courses offered by the Faculty are categorized as core courses, faculty and inter-faculty electives. An MS student will be required to take seven/eight courses, of which three should be core courses and the rest elective



courses appropriate to the specific degree program in Materials Engineering or Chemical Engineering as per consultation of the graduate advisor. On recommendations and approval, a graduate student may also register for one 4XX level course. Overall, 30 credit hours should be maintained.

PhD Degree:

The courses to be taken by the student will be recommended and endorsed by the graduate advisor and Departmental Academic Committee respectively. Of the six courses at least five (05) must be from the list of DMSE or DCME courses and the remaining from other faculties. Overall, 36 credit hours should be maintained including 18 hours of PhD Dissertation.

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.

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.



DEPARTMENT OF MATERIALS SCIENCE & ENGINEERING

The Department of Materials Science and Engineering is ranked among the top in Materials Engineering category in KP and the third best in Pakistan with respect to the quality of research and excellence in teaching as per the recent HEC survey. Since its birth, there have been enriched contributions by local and foreign expertise which played a key role to its evolution into one of rapidly emerging departments in the country. Since then a number of Masters and PhDs have benefitted from its facilities and have established successful careers in research and academia.

Currently, the Department offers the following graduate degree programs:

- I. Masters in Materials Engineering
- II. Masters in Nanotechnology and Materials Engineering
- III. PhD in Materials Engineering

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 can excel

in academia, research, business and industry.

Thrust Areas:

The graduate program in Materials Engineering consists of lectures and hands-on research training emphasizing underlying principles and their engineering applications. A number of core and elective courses are offered as per the graduate approved degree plan leading them to earn Masters (MS) or Doctor of Philosophy (PhD) degrees in their respective fields of specialization.

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

- (i) Phase Transformations in Materials
- (ii) Advanced Processing and Characterization of Materials
- (iii) Nanomaterials and Nanotechnology
- (iv) Composite Materials and Ceramics
- (v) Surface engineering and Coating Technology
- (vi) Corrosion and Oxidation
- (vii) Biomaterials
- (viii) Advanced Alloys and Bulk Metallic Glasses
- (ix) Failure Analysis
- (x) Energy Materials



List of Courses for Materials Engineering Program**(A) Core Requirement (09 CH)**

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

(B) Program Technical Electives (06 CH)

Course Code	Course Title
MM511	Advanced Thermodynamics of Materials
MM522	Theory of Dislocations
MM523	Materials Selection and Failure Analysis
MM524	Metal Forming
MM532	Thermomechanical Processing
MM533	Microstructural Control
MM534	Advanced Manufacturing Systems
MM535	Advanced Joining Technology
MM541	Process Metallurgy and Extraction
MM543	Solidification Processing
MM544	Modern Steels and Processes

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

Course Code	Course Title
NM536	Nanoengineering and Smart Materials
MM545	Advanced Biomaterials
MM561	Carbon Materials
NM562	Carbon Nanomaterials and Fabrication
NM568	Advanced and Nanostructured Materials
NM573	Nanomaterials and Computer Aided Nanodesign

MM591	Electron Microscopy
MM551	Corrosion Monitoring and Prevention
MM553	Advanced Surface Engineering
MM554	Advanced Coatings
MM555	Tribology of Engineering Materials
NM556	Thin Film Technology
MM563	Advanced Analytical Techniques
MM564	Polymer Science and Engineering
MM565	Ceramics Engineering
MM566	Electronic & Magnetic Materials and Devices
MM567	Composite Materials
MM569	Advanced Functional Materials
Mm592	Advanced X-ray diffraction and texture analysis technique
MM571	Computational Materials Science
MM572	Engineering Design
MM573	Materials for Energy Applications

(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
MM583/EM5XX	Technology Management

*A student who already registered and passed NM556 Thin Film Technology course (from Nanotechnology and Materials Engineering program), cannot register for ES514.

(E) Graduate Thesis (06 CH)

Course Code	Course Title
MM599	MS Thesis

(F) Total Credit Requirements (30 CH)

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



List of Courses for Nanotechnology and Materials Engineering Program

(A) Core Requirement (09 CH)

Course Code	Course Title
NM537	Advanced Nanostructures and Devices
NM569	Nanotechnology
NM593/MM593	Advanced Characterization Techniques

(B) Program Technical Electives (06 CH)

Course Code	Course Title
NM536	Nanoengineering and Smart Materials
NM556	Thin Film Technology
NM562	Carbon Nanomaterials and Fabrication
NM568	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

(F) Total Credit Requirements (30 CH)

For the award of MS degree in Nanotechnology and Materials Engineering, a student has to complete 30 credit hours.

COURSE DESCRIPTION

MM511 Advanced Thermodynamics of Materials (3-0-3):

Review of fundamentals of classical thermodynamics, 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 order 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; advanced treatment, Plasticity; theories of plasticity, Dislocation effects and geometry of deformation, Strengthening mechanisms, Deformation of composites, Single and polycrystalline materials, Fracture mechanics, High temperature fracture, Embrittlement and radiation damage

MM522 Theory of Dislocations (3-0-3): Physical basis for dislocations and their elementary geometric properties, Theory of straight and curved dislocations,

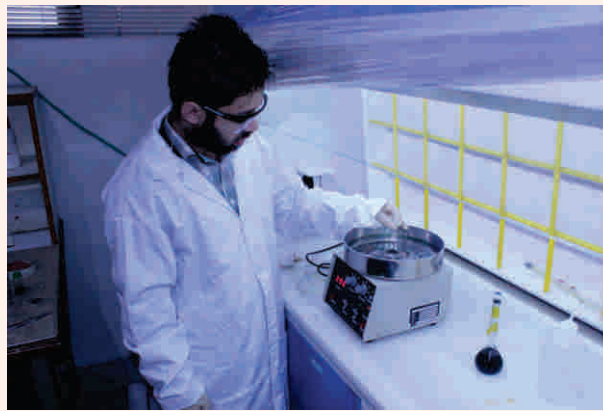
Dislocation interactions, Effects of crystal structure on dislocations, Slip systems of perfect dislocations, Partial dislocations in FCC and other structures, Dislocations in ionic crystals, Dislocation motion and effects on strength and work hardening, Effect of temperature on dislocation movement

MM523 Materials Selection and Failure Analysis (3-0-3):

Selection, Utilization, economics and technical aspects of engineering design and applications, Analysis of failed structures due to overload, creep, fatigue, corrosion, wear and impact with extensive use of analytical techniques, Identification and role of processing, manufacturing and service related defects in failure.

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 properties



MM531 Phase Transformations in Materials (3-0-3):

Equilibrium transformations; first order and second order, Order-disorder transitions, Transformations in complex structures, Diffusional and diffusionless transformations, thermodynamics and kinetics, Homogeneous and heterogeneous nucleation, Interfaces, grain boundaries and microstructures, Precipitation phenomena and influence on properties, thermomechanical treatment, ECAP, ultrafine grained steels and alloys, Micro- and Nanophases in alloys and Materials

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

MM533 Microstructural Control (3-0-3): Stored energy of cold work, Relation between free energy and strain, Release of stored energy, Recovery; recovery in single crystals, polygonization, dynamic recovery, recrystallization, Effect of time and temperature, Effect of strain, Nucleation of recrystallization, theories of formation, rate and growth of nuclei, recrystallized grain size, Grain growth; effect of impurities and inclusions, Limiting grain size, Preferred orientations, Secondary recrystallization, Strain induced boundary migration

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, SPC and charts, design and process planning, quality control.

MM535 Advanced Joining Technology (3-0-3):

Advanced joining processes, mechanical joints and design, fusion and welding joints and welding techniques, standards, codes and procedures, NDT analysis and quality inspection, ferrous and nonferrous materials joining, joining of dissimilar materials for hi-tech applications, brazing tools for high performance machining, lead-free solder systems and modelling for electronic circuits, surface mount technology (SMT), adhesive joining technology, polymers and PMC joining methods

NM536 Nanoengineering and Smart Materials (3-0-3):

Manufacturing of nanoscale materials, fabrication tools for nanostructures and nanodevices, nanofabrication, nanotribology, nanoindentation, surface science and properties, multi-scale modeling of stress localization and fracture of nanocrystalline materials, nanoscale intelligent and smart materials and structures.

NM537 Advanced Nanostructures and Devices (3-0-3):

Design of nanoscale materials, nanostructure and physical properties, modelling and simulation, nano-device fabrication techniques, nanoparticles, nanowires, nanorods and thin film technology, sensors and devices, MEMS and NEMS, field emission devices



MM541 Process Metallurgy and Extraction (3-0-3):

Free energy of formation, Free energy diagrams. Limitations of free energy diagrams and the phosphorus reaction in steelmaking, Gas-solid reactions in calcination, roasting and reduction, Liquid-solid reactions in leaching, Liquid-liquid reactions at slag-metal interface, 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, castings and ingots, Fluid flow, Nucleation and growth, modeling of solidification process, dendrite and constitutional supercooling, semisolidification casting, rheology and modern methods of 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 operations and productivity, electric steel making operations and productivity, Methods of enhancing productivity and efficiency, Direct reduction, Strip and twin-roll casting and interface reaction, Segregation, Solidification processes, thermomechanical treatments, alloy steels, stainless steels, DSS and structural steels.



MM545 Advanced Biomaterials (3-0-3): Biomaterials and their classification, cell/materials interaction and biocompatibility, synthesis and production methods, advanced alloys for production of hip joints, prostheses, and implants, hydroxyapatite (HA) surface coatings, dental materials, bio-glasses and bone cements, , new materials (nano biomaterials) and advanced processing technology, modeling and design aspects, organic and composite materials for biomedical applications.

MM551 Corrosion Monitoring and Prevention (3-0-3):

Electrochemical thermodynamics and kinetics, Anodic and cathodic polarization curves, Corrosion behavior diagrams, Potentiostatic and potentiodynamic measurements, Galvanostatic behavior of metals, Tafel slope, Polarization resistance measurement, Corrosion rate determination, Pitting potential and pitting resistance, Electrochemical Impedance Spectroscopy (EIS), Nyquist and Bode plots, Performance of materials in specific environments, Soil potential and resistivity measurement, Coatings and inhibitors, Pipeline and oil rig protection

MM553 Advanced Surface Engineering (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.

MM554 Advanced Coatings (3-0-3): Classification of Surface Coatings, Coatings for Mechanical Applications, Corrosion Resistant and Thermal Barrier Coatings, Chemical Methods for Surface Coatings, Thermal Methods for Surface Coatings, Plasma Spraying, Thin Films, PVD, CVD and PECVD techniques, Coating Growth, Coating Characterization and applications

MM555 Tribology of Engineering Materials (3-0-3): Hard coatings and surfaces, friction and wear behavior of materials, engineering applications, contact surfaces and interface properties, lubricants, modeling of wear behavior, rolling contact fatigue, nanotribology.

NM556 Thin Films Technology (3-0-3): Thin film growth techniques, PVD, CVD, MBE, magnetron CVD process, diamond like (DLC) coatings, tribological and hard coatings for tools and engineering applications, functional coatings for electronic and magnetic materials applications, evaporation and sputtering techniques, atomic layer deposition (ALD), advanced surface characterization techniques.

MM561 Carbon Materials (3-0-3): Carbon blacks, cokes, graphites, diamonds, structure and property relationships, intercalation compounds, processing and mesophase, applications in tiers, pigments, catalysts, friction, electrocommutation, Modern carbon, graphite, fullerenes, C60 and other forms, foams and felts, nanoparticles, synthetic diamond and diamond-like coatings (DLCs)

MM562 Carbon Nanomaterials and Fabrication (3-0-3): Fullerenes and their derivatives, 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.

MM563 Advanced Analytical Techniques (3-0-3): Introduction, instrumentation for analytical measurements, Spectroscopic background (mathematical and physical approaches, Practical applications, examples), Absorption spectroscopies, emission spectroscopies, Fluorescence spectroscopies, Resonance spectroscopies, vibrational spectroscopies, Case studies

MM564 Advanced Polymer Science and Engineering (3-0-3): Introduction to the molecular, morphological, mechanical and other properties of conventional and engineering polymers. Major topics include: Configuration of Polymer chains, Thermodynamics and phase equilibria in polymer systems, Viscoelasticity and rubber elasticity, Deformation mechanisms in glassy amorphous polymers and toughening mechanisms

MM565 Advanced Ceramics Engineering (3-0-3): Origin of Ceramics, Physical and Thermal properties of Ceramics, Structure of Ceramics, Concept of Long Range order in Ceramics, Non Oxide Ceramics, Processing of ceramic Powders, Powder Characterization and data analysis, Sintering Thermodynamics and Kinetics, Novel Sintering Techniques, Characterization of Sintered Products, Study of Transition Aluminas and Transformation Toughening in Ceramics

MM566 Electronic and Magnetic Materials and Devices (3-0-3): Introduction to NFE theory of condensed materials, Fermi-Dirac statistics, band theory of solids, electrons and holes in semiconductors. Dielectric and magnetic properties of solids. Practical,

modern magnetic materials. Introduction to semiconductor devices and their processing

MM567 Advanced Composite Materials (3-0-3):

Composites, basic principles, applications and properties of engineering materials, processing of reinforcements – particulates, whiskers and long fibres, Methods of production for MMCs, CMCs and OMCs, Mechanical behavior of composite materials, Fracture mechanics, Nanocomposites

NM568 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 – twin-roll and rapid solidification casting, Thermomechanical processes, Production of fine metallic powders, Mechanically alloying, High temperature materials for power plants and aerospace applications, Automotive materials, Shape memory alloys, Biomaterials, High temperature materials and coatings, Superplasticity, Ti- and Al- based alloys, Nanostructured and smart materials, Special topics include: Advanced characterization techniques, Applications and processing of MMCs, CMCs, OMCs and nanocomposites and nanostructured materials

MM569 Advanced Functional Materials (3-0-3): The crystal structure of solids, phase transformations and relations between crystal structure and functional properties, organic and inorganic functional materials. Synthesis and processing of functional materials i.e. Shape memory materials, superelastic materials, thermoelectric generators, piezo electric materials, ionic conductors etc. Applications of functional materials in biomedical devices, electronics, optics and other advance applications. Ionic conductors in batteries, sensors and fuel cells. Materials for energy biomedical devices technology.

NM569 Nanotechnology (3-0-3): Introduction to nanotechnology, Processing and synthesis, particles and nanoparticles Carbon nanotubes, C60, SWT and MWT, carbon clusters, synthetic and nanocrystalline diamond, structure, properties and applications, solid fuels, sensors, catalysts and reinforcements, self-assembly and catalysis, Organic and biomedical materials, nanostructured materials, Nanomachines and nanodevices

MM571 Computational Materials Science (3-0-3):

Statistical methods in data processing and prediction of materials behave, Transport equations and the relevant problems in materials science and engineering, Imaging technologies in materials studies, First principle Monte-Carlo simulations in materials science and engineering, (Application of Monte-Carlo technique to RXN and grain growth)

MM572 Engineering Design (3-0-3):

A materials approval to the design process, methods, modeling and simulation, optimization and interaction of materials selection, processing and design, economic decisions, planning and scheduling, engineering statistics, risk and reliability, quality, information sources and communicating of design



Nm573 Nanomaterials and Computer Aided Nanodesign (3-0-3): Manufacturing, super modeling, simulating solids at atomic level, computational software for modeling and nanodesign, computational engines for molecular dynamics (MD) for modeling such as atomic transport or thermal conductivity over very short time period.

EN521/MM581/ME597 Industrial Safety (3-0-3): Accident prevention, Ergonomics and protective equipment, Fire prevention and control, Concept of total loss control

MM582/ME598 Industrial Management (3-0-3): Production management and decision making, Analytical and quantitative methods of management, Planning organization and control of production systems, Plant layout, Work and method study

MM583/EM5XX Technology Management (3-0-3): Materials management, Production planning and systems, Quality control, Materials requirement and planning, Capacity management, Productivity, Forecasting, Inventory, demand and ordering systems, Management supply chain modules, TQM

MM591 Electron Microscopy (3-0-3): Specimen preparation techniques, Image forming techniques, Image forming techniques and crystallographic information, Image interpretation and characterizations of microstructures, Convergent beam, weak beam and microanalysis of thin foils, Introduction to electron microscopy. Micro and nanostructure analysis, Working principles of different types of electron microscopes; TEM, SEM, STEM, HREM

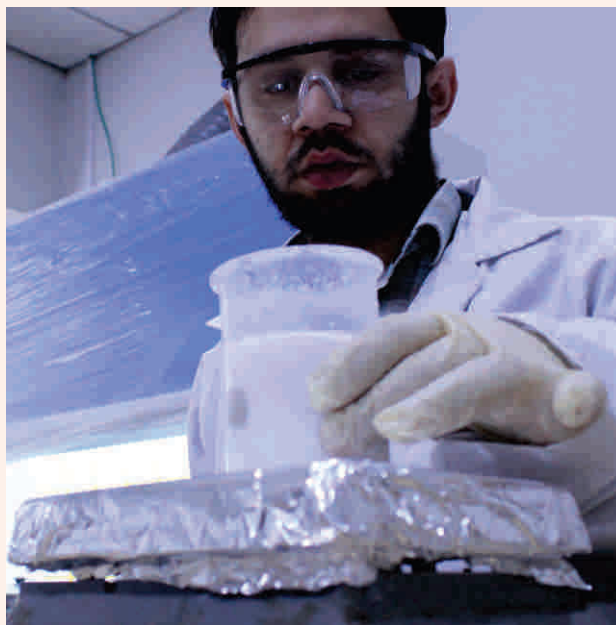
MM592 Advanced X-ray Diffraction and Texture Analysis (3-0-3): X-ray scattering by noncrystalline forms of matters, effects of temperature, atoms, crystal axes and reciprocal lattice, diffraction by small crystals,

integrated intensity, crystal symmetry, the powder method, the Laue method, the rotation method, scattering by non-crystalline form of matter, temperature effect, order-disorder diffraction by imperfect crystals and perfect crystal theory.

MM593/NM593 Advanced Characterization Techniques (3-0-3): Scanning probe microscopy (SPM), AFM and its derivatives, surface nanotechnology, high resolution transmission electron microscopy, field emission gun environmental scanning electron microscopy (FEG-ESEM) for solids and liquids, XPS and Auger electron microscopy, micro-Raman spectroscopy.

MM599/NM599 MS Thesis (6)

MM699 PhD Dissertation (18)



DEPARTMENT OF CHEMICAL ENGINEERING

The dynamics of research and process industry require professionals who can upgrade the present manufacturing processes, develop and design alternative technologies. The department is launching Masters (MS) and doctor of philosophy (PhD) in Chemical Engineering. The graduate program in Chemical Engineering is especially designed to provide excellent opportunities to the students who will be seeking for higher studies.

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

Thrust Areas

The graduate program in Chemical Engineering consists of lectures and hands-on research training emphasizing

underlying principles and their engineering applications. A number of core and elective courses are offered as per the graduate approved degree plan leading them to earn a Masters (MS) or Doctor of Philosophy (PhD) degrees in their respective fields of specialization.

The Graduate Programs can be pursued in one of the following research areas but not limited to these as student can opt the research area as per his/her interest and supervisor advice:

- (i) Process & equipment design
- (ii) Fluid handling and thermodynamic behavior
- (iii) Reaction engineering
- (iv) Transport processes
- (v) Modeling and simulation



Details of Courses:**Core Courses**

CH501	Chemical Thermodynamics
CH502	Chemical Reaction Engineering
CH516/ES531	Computational Methods for Engineers
CH512	Experimental Design and Analysis
CH503	Transport Phenomena

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
CH532	Project Management

(B) Process Engineering

CH503	Transport Phenomena
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

COURSE 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 multi-component 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



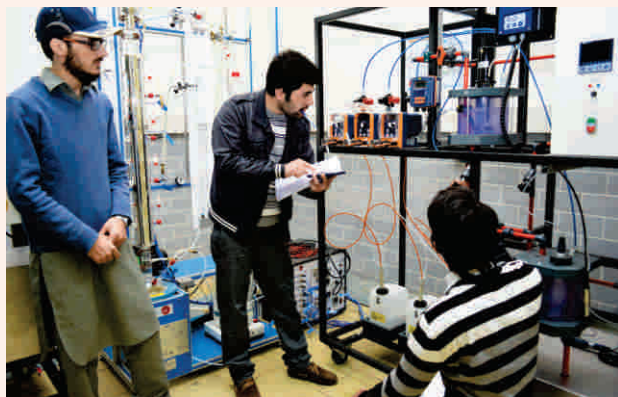
and anaerobic processes; Nitrification and Denitrification processes. Stirred tank bioreactor. Jet bioreactor. Reciprocating jet bioreactor. Hollow fiber bioreactor. Fluidized bed bioreactor. Application of various bio processes for the treatment of industrial wastes and production of chemicals. Theory of Biochemical 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.

CH528 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 impact analysis, policies and regulations, resource depletion and substitution, three Rs: reduce, reuse & recycle.

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 multiphase 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)

CH699 PhD Dissertation (18)



FACULTY OF MECHANICAL ENGINEERING



THRUST AREAS

Design and Manufacturing,
Thermo Fluid,
System Dynamics and Control,
Computational Mechanics



Faculty

S. M. Ahmad, Dean	PhD (University of Sheffield, UK, Chartered Engineer, MIMechE)
Mykola Bannikov	PhD (USSR)
Wasim Ahmed Khan	PhD (University of Sheffield, UK), CEng, FIMechE, Senior Member, IEEE
Ghulam Hussain	PhD (Nanjing University of Aeronautics & Astronautics, Nanjing, China)
Khalid Rehman	PhD (Jeju National University South Korea)
Taqi Ahmad Cheema	PhD (Kyungpook National University, Daegu, South Korea)
Sohail Malik	PhD (Università of Politecnica Delle Marche, Ancona, Italy)
Muhammad Asif	PhD (Hanyang University, South Korea)
Muhammad Ilyas	PhD (Institut Supérieur de l'Aéronautique et de l'Espace, ISA-SUPAERO, France)
Adnan Hassan	PhD (Koç University, Istanbul, Turkey)
Ahmad Abbas	PhD (GIK Institute, Pakistan)
Massab Junaid	PhD (GIK Institute, Pakistan)

Personal Assistant

Mr. Nizakat Ali Khan	MBA (VU, Pakistan)
	M.A Political Science (University of Peshawar), Pakistan



Dean

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 and 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, mechanical engineering design, transportation systems, and systems and control.

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
- iv. Computational Mechanics

The FME offers courses leading to both Master (MS), and

Doctor of Philosophy (Ph.D.) 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.

COURSE WORK:

MS Degree

The courses offered by the FME are categorized as core courses, faculty and inter-faculty electives. An MS student, specializing in any area, will be required to take a total of 24 credits (generally 8 courses of 3 credits each) based on the following distribution.

Core Courses	Faculty Electives	Other - Faculty Electives
Minimum 4	2	Maximum 2*

In addition to above distribution a maximum of two 400 level FME courses may also be allowed.

* With the permission of advisor and approval by the Dean



PhD degree

The courses to be taken by the student will be decided by his/her Doctoral Committee and approved by the Dean of Graduate School. Five out of the eight courses must be from the list of FME courses, and the remainder may be from other Faculties.

LIST OF COURSES**CORE COURSES**

Mathematics or Numerical Methods course is to be taken from the courses offered by the Faculty of Engineering Sciences or any other related faculty.

ME506	Continuum Mechanics
ME521	Intermediate Fluid Mechanics
ME531	Heat Transfer I
ME533	Engineering Thermodynamics I
ME514	Advanced Stress Analysis
ME516	Applied Finite Element Analysis
ME517	Theory of Vibration
ME557	Engineering Plasticity
ME567	Applied System Dynamic and Control
ME581	Manufacturing Systems
ME582	Product Design
ME583	Design Optimization and Analysis Techniques
ES533	Numerical Method for partial differential equations



ELECTIVE COURSES**i. Design and Manufacturing**

ME512	Advanced Solid Mechanics
ME513	Theory of Plates and Shells
ME515	Finite Element Method
ME540	Analytical Methods for Partial Differential Equations
ME553	Design of Machine Tools
ME554	Artificial Intelligence in Design and Manufacturing
ME555	Joining of Advanced Materials
ME556	Quality Assurance
ME562	Advanced CAD/CAM
ME563	Mechanism Design
ME565	Tribology
ME582	Product Design
ME583	Design Optimization and Analysis Techniques
ME566	Pressurized Systems
ME582	Product Design
ME585	Materials Design and Processing
ME587	Digital Manufacture and Rapid Manufacture
ME588	Process Planning & Computer Aided Manufacturing
ME589	Modelling, Simulation, and Visualization
ME590	Design Management and Prediction
ME591	Robotics and Manufacturing Automation
ME592	Advanced Laser Processing
ME593	CAD and Product Data Management
ME597	Industrial Safety
ME598	Industrial Management
ME611	Fracture Mechanics
ME612	Finite Element Methods in Manufacturing Processes

ii. Thermo-Fluid

ME522	Viscous Flow
ME524	Computational Fluid Dynamics
ME525	Fluid Mixing and Separation
ME532	Heat Transfer II
ME534	Boiling and Condensation Heat Transfer
ME535	Industrial Air Conditioning and Refrigeration
ME536	Internal Combustion Engines
ME537	Fluidized Bed Combustion
ME538	Engineering Thermodynamics II
ME539	Thermal Design of Heat Exchangers
ME540	Analytical Methods for Partial Differential Equations
ME566	Pressurized Systems
ME586	Advanced Heat Transfer
ME595	Solar Energy Utilization
ME596	Energy Management
ME621	Boundary layer Theory
ME622	Hydrodynamic Stability
ME623	Two Phase Flow
ME624	Turbulence

iii. Dynamics & Control Systems (DCS)

ME505	Parameter Estimation
ME511	Advanced Dynamics
ME540	Analytical Methods for Partial Differential Equations
ME552	Robotics
ME554	Artificial Intelligence in Design and Manufacturing
ME564	Automation and Control
ME589	Modelling, Simulation, and Visualization
ME591	Robotics and Manufacturing Automation
ME622	Hydrodynamic Stability

iv. Computational Mechanics

ME511	Advanced Dynamics
ME515	Finite Element Method
ME5XX	Mechanics of Composite Materials
ME6XX	Additive Manufacturing

Project / Thesis:

ME599	MS Thesis
ME699	PhD Dissertation

COURSE DESCRIPTION

ME505 Parameter Estimation (3-0-3): Estimation of parameters in ordinary and partial differential equations. Related concepts in probability and statistics. Least squares and other estimators. Sequential methods. Optimum Experiment Design.

ME506 Continuum Mechanics (3-0-3): Development of mathematical tools, Cartesian tensors. Continuum hypothesis. Deformation. Motion. Stress. Fundamental laws of Continuum Mechanics. Application to solids. Application to fluids.

ME511 Advanced Dynamics (3-0-3): Hamilton's Principle, generalized variables, Lagrange's equation, Rigid body dynamics and systems with gyroscopic effects on spinning shafts and critical speeds, Gyro-compass, Inertial navigation, Vibration of systems with time varying and non-linear characteristics, Hamilton's principle applied to distributed systems and to systems with electro-mechanical transducer components.

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, thermoplasticity, viscoelasticity, Plasticity, viscoplasticity, damage mechanics, crack mechanics.

ME513 Theory of Plates and Shells (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.

ME514 Advanced Stress Analysis (3-0-3): Transformation of stresses, brittle coatings, photo-elasticity (2D and 3D) analysis, strain gauges (2D and 3D) analysis, Moire fringes, grid methods, analogies and the applications on static and dynamic problems.

ME515 Finite Element Method (3-0-3): Introduction to 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.

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

Introduction to FEA, structures, geometric nonlinearities, material nonlinearities, Electro-magnetic problems, heat flow problems, fluid flow and acoustics problems, coupled effects, shape functions, element tools, element library, analysis tools, analysis procedures, pre and post processing tools, design optimization.

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

Properties of vibrating system, Orthogonality of Eigen vectors, modal matrix, normal mode summation, computational methods, Gauss elimination, matrix iteration to the Finite Element Method, mode summation procedures for continuous systems, random vibrations, non-linear vibrations, perturbation method, phase plan, modal analysis.

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

Continuum properties. Control volume formulation of the conservation laws including deformable control volume, Euler equation, Navier Stokes, and energy

equations, some exact solutions, Vorticity and circulation, Inviscid flow considerations, Potential flows, Boundary layers, Measurement techniques in fluid mechanics.

ME522 Viscous Flow (3-0-3):

Introduction, properties of fluids, boundary conditions. Fundamental equations of compressible viscous flow, Dimensionless parameters, solutions to Newtonian viscous flow equations. Laminar boundary layers, stability of laminar flows, Incompressible turbulent flows, Compressible boundary layer flows. Finite difference analysis and digital computer solutions of various problems.

Pre-requisite(s) ME 521

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

Introduction; partial differential equation; Basics of finite-difference methods; Concepts of error, consistency and stability; Momentum and energy equations; Diffusion equations; Turbulence modeling; Boundary layer computational methods; Hyperbolic equations; 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. Solid-Liquid and Liquid-Liquid Separation: Principles, methodologies and equipment. Cyclone Separators.

Pre-requisite(s): ME 521, ME 522.

ME531 Heat Transfer I (3-0-3):

Formulation of steady and unsteady, multidimensional conduction in different geometries. Methods of solution including separation of variables, integral transformation, and numerical means. Electromagnetic background and definitions. Interaction of radiation with homogenous matter and with interfaces. Black body radiation. Radiation from real surfaces. Radiative energy transfer between surfaces and enclosures.



ME532 Heat Transfer II (3-0-3): Equation of motion, Formulation of laminar, free and forced convection including integral techniques, Methods of solution: Similarity, perturbation, turbulent diffusivities. Prandtl and Karman's theories, Analogy between heat and momentum transfer, Reynolds, Taylor, Prandtl and Martinelli analogies.

ME533 Engineering Thermodynamics-I (3-0-3): Elements of thermodynamics terminology, first law for closed systems, work transfer, first law for open systems, second law for closed systems, second law for open systems, lost available work, cycles, entropy generation and exergy destruction, single-phase systems, generalized energy analysis, air conditioning applications, multiphase systems, chemically reacting systems.

ME534 Boiling and Condensation Heat Transfer (3-0-3): Thermodynamics of vapor/liquid systems; basic processes of boiling; pool boiling, convective boiling; single phase heat transfer; onset of sub cooled boiling; saturated boiling heat transfer; critical heat flux in forced convective flows; condensation and evaporation at a liquid-vapor interface; film and drop wise condensation;



augmentation techniques.
Pre-requisite(s) ME 532.

Me535 Industrial Air Conditioning and Refrigeration (3-0-3): Summer and winter air conditioning load calculations, air conveying and distribution, fans, duct design, and diffusion apparatus for producing comfort in summer. All year air conditioning methods and equipment, automatic control for air conditioning systems. Refrigeration load, selection of all units and writing specifications for all equipment for the design work, methods of development for the design work, methods of development studies in air conditioning industries. Mechanical Engineering.

ME536 Internal Combustion Engines (3-0-3): Properties of working fluid. Scavenging in two-stroke cycle engines, supercharging. Modeling real engine flow and combustion processes. Engine operating characteristics.

ME537 Fluidized Bed Combustion (3-0-3): Fundamentals of fluidization. Heat transfer in fluidized beds. Combustion in fluidized beds. Materials handling. Thermodynamic cycles with fluidized bed boiler. Recent developments in fluidized bed technology. Specific problems of fluidized bed combustor.

ME538 Engineering Thermodynamics II (3-0-3): Power generation, maximum power conditions, External irreversibility, Advanced steam-turbine power plants, Advanced gas-turbine power plants, Combined steam-turbine and gas-turbine cycles, Solar power, Extraterrestrial power plants, Refrigeration, Liquefaction, Magnetic refrigeration, Thermodynamic design: Heat exchangers, Thermal energy storage, Mass exchanger. Pre-requisite(s): ME 533.

ME539 Thermal Design of Heat Exchangers (3-0-3): Classification of a variety of heat exchangers, various

methods for the exchanger analysis and performance evaluation, pressure drop analysis including header design and flow maldistribution, fouling and its impact on the exchanger performance and life-cycle analysis. Special design considerations for regenerators, plate-fin, tube-and-frame, shell-and-tube, reboilers, condensers, evaporators, and direct-contact heat exchangers.

ME540 Analytical Methods for Partial Differential Equations (3-0-3): Introduction and Classification, Boundary Conditions, Wave equation, D'Alembert's solution, Method of characteristics, Separation of variables, Diffusion equation. Application of Fourier series, Sturm-Liouville theory, Orthogonal Eigenfunctions, PDEs in cylindrical coordinates, Fourier-Bessel series, Steady-state and time-dependent problems involving cylinders, Problems in spherical geometry. Fourier-Legendre series, Spherical Bessel functions for time-dependent problems, Non-homogeneous PDEs, Poisson's equation, Green's functions for partial differential equations.

ME552 Robotics (3-0-3): An overview of Robotics, Forward kinematics, Inverse kinematics, Denavit-Hartenberg coordinate transformations, Motion/kinematics, Force/Torque relations, Trajectory planning, Dynamics, Lagrange equations, Position control, PID control, Inverse dynamics feed forward control, Nonlinear and two parts control.

ME553 Design of Machine Tools (3-0-3): Types of machine tools, General requirement 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 dynamics.

ME554 Artificial Intelligence in Design and

Manufacturing (3-0-3): Applications of artificial intelligence to design and manufacturing, Principles, strengths, and limitations of existing techniques, Knowledge representation issues and techniques, Prolog, expert systems, machine learning.

ME555 Joining of Advanced Materials (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 of glasses, polymers, composite materials, dissimilar material combination.

ME556 Quality Assurance (3-0-3): Genesis of total quality control, planning process, process management, employee participation, quality control review, relevant standard.

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

ME562 Advanced CAD/CAM (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, bicubic surface paths, image generation, Numerically controlled tool paths, advanced research topics, project management for software development.

ME563 Mechanism Design (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.

ME564 Automation and Control (3-0-3): Theory and techniques of high-level control, strategies and decisions at symbolic level, Symbolic description of process behavior. Pattern classification and clustering, in process monitoring and sensor fusion, 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 (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, Elastohydrodynamic lubrication, Extreme pressure lubrication.

ME566 Pressurized Systems (3-0-3): Background analysis and shell theory, plasticity, limit analysis and shakedown, design by rule, design by analysis, local loads, supports and mountings, nozzle design and branch connections, design rules for dished ends including buckling aspects, design of externally pressurized vessels, fatigue aspects of design, tube sheet design, flange design.

ME567 System Dynamics and Applied Control (3-0-3): Introduction to modelling of dynamical mechanical systems, mathematical modelling of mechanical and electro-mechanical systems, review of classical control techniques and concepts, state variable techniques, design of control systems in state-space, digital control, practical case studies.

ME581 Manufacturing Systems (3-0-3): Introduction, Engineering Design and Manufacturing, Manufacturing and Production, Machine Tools and Manufacturing Equipment, Engineering Design and Manufacturing of Machine Tools, Components and Classification of Manufacturing Systems, Assembly Lines, Production Philosophies, Occupational Health and Safety, Sustainability.

ME582 Product Design (3-0-3): Design process, advanced technology for design process, idea generation and creative problem solving, Project-centered subject addressing transformation of new ideas into technology based products, attaining a proper match between product and marketplace. Product design specification, Product design issues: evaluation, market perception, aesthetics and human interfacing, Design for manufacturability, reliability, and repair ability, pricing and legal implications.

ME583 Design Optimization and analysis techniques (3-0-3): Introduction to Computer Aided Engineering Design. Engineering problem solving using ANSYS

applied to a range of practical and industrially relevant stress analysis and heat transfer problems. Solid modeling, selection of boundary conditions, practical modeling, verification of models and analysis, post processing and checking of results. Model optimization. Case studies. Introduction to geometric modeling technology and associated computational geometry. A study of data exchange issues related to analysis and simulation. An overview of sensitivity studies and shape optimization. An insight into the analysis and simulation of plastic and composite components.

ME584 Design Methodology, Techniques & Tools (3-0-3): Introduction to Design Methods, Tools & Techniques; Artefact & Process Design, Theories; The Basic Design Cycle; Tools & Methods For Design Problem Analysis (QFD, etc); Tools & Methods For Design Solution Synthesis (Morphological Charts, Brainstorming etc.), Tools & Methods For Solution Analysis & Evaluation (FMEA, Decision Matrices etc), Concept generation (Creative design) and evaluation methods, Detailed design methods, Project definition methods, PDS, QFD, Customer analysis, Design for X, Computer support design methods, e.g. Expert systems, KBS etc. Introduction to optimization in product develop, Principles of electro-mechanical design

ME585 Materials Design and Processing (3-0-3): Advanced materials: composite materials, cellular structural materials, laminate materials; Materials selection: metals, polymers, wood, textiles; Materials processing: metals working, diamond synthesis, polymer production.

ME586 Advanced Heat Transfer (3-0-3): Heat Conduction, Heat Conduction-Rectangular Coordinates., Heat Conduction-Cylindrical Coordinates, Method of separation of variables, Advanced Mathematical Tools to Solve Transient Heat Conduction Problems, Convective Heat Transfer: Fluid Dynamics

Introduction, Convective Heat Transfer: Limiting Condition Flows, Convective Heat Transfer: Laminar Heat Transfer, Convective Heat Transfer: Thermal Boundary Layers (Similarity Solutions), Convective Heat Transfer: Turbulent Heat Transfer, Special Topics related to heat transfer in manufacturing processes. Numerical Methods in Heat Transfer and CFD.

ME587 Digital Manufacture and Rapid Manufacture (3-0-3): Computer numerical control and machine tool; Computer aided manufacture; Programmable logic controller used in manufacturing processes; Computer aided process planning; Flexible manufacturing system; Distributed numerical control; Digital manufacturing methods and tools; Contemporary integrated manufacturing.

ME588 Process Planning & Computer Aid Manufacturing (3-0-3): Technologies: NC machines, cutting tools; Methods: Process planning (tools and parameters selection), tolerancing; Software: CAM software, CAD/CAM link, CAM simulation, post-processing

ME589 Modelling, Simulation and Visualization (3-0-3): Integrated product aspects modeling: Solid modeling, Kinematic modeling, mechanism simulation, finite element analysis; Automatic Dynamic Analysis of



Mechanical Systems, Dynamics behavior modeling; Computer graphics in product visualization, computer modeling environment and its effect of product modeling; Web-based product modeling and visualization. Project of creating a functional product model to demonstrate the usefulness of advanced CAD systems.

ME590 Design management and prediction (3-0-3):

Design process models – whole product development, Design decision making and their impacts; Teams, Organization of design; Project planning, human resource allocation, both at project and company levels. Costing of products and cost estimation of products at early design, Information and knowledge management, Overview of methods, tools and techniques, Globalization and extended design supply chain, Collaborative working, distributed design

ME591 Robotics and manufacturing automation (3-0-3):

Industrial robot and robotics, robot kinematics, robot dynamics, trajectory planning of robot, intelligent and adaptive control of robot, robot programming, application of industrial robot, such as welding robot, assembly robot, painting robot, automated guided vehicles, shop floor control system, job-shop scheduling, materials requirement planning, manufacturing resources planning.

ME592 Advanced Laser Processing (3-0-3):

This module is to increase the knowledge of advanced laser processing, and laser applications in industry and other fields. On completion of the module, the students should be able to: (a) Have a basic understanding of laser processing and their application in engineering; (b) Understand the systematic requirement for laser processing; (c) Appreciate and understand the knowledge of laser processing in microelectronics and industry, such as drilling, marking, welding, microfabrication and structuring, laser rapid

prototyping, etc.

ME593 CAD and Product Data Management (3-0-3):

Computer Aided, Design, Computer Aided Manufacturing, Computer Aided Engineering, Digital Mock-Up, Product Data Exchange, Engineering Data Management, Product Data Management, Product Lifecycle Management.

ME595 Solar Energy Utilization (3-0-3):

Advanced topics including passive, active and hybrid heating techniques, thermal storage and solar ponds, equipment in solar systems, solar distillation and evaporation, solar cooling and refrigeration, solar pumping and irrigation, high temperature applications, photovoltaic, comparison of other renewable energy resources, biomass, wind energy etc. with Solar Energy.

ME596 Energy Management (3-0-3):

Energy scene, Thermodynamics and energy, heat and mass transfer, waste heat recovery, vapor diffusion and condensation. Energy surveys and energy audits; laws of energy and Materials flows, checklists for energy managers, case study generation, evaluation and optimization of options for energy conservation.

ME597 Industrial Safety (3-0-3):

Accident prevention. Ergonomics and protective equipment. Fire prevention and control. Concept of total loss control.

ME598 Industrial Management (3-0-3):

Production management and decision making. Analytical and quantitative methods of management. Planning organization and control of production systems. Plant layout. Work and method study.

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): 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.
Pre-requisite(s): ME 515.

ME621 Boundary Layer Theory (3-0-3): 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.
Pre-requisite(s): ME 521.

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

ME623 Two Phase Flow (3-0-3): Liquid-Solid, Liquid-vapor, Solid-gas flows, Flow regimes of liquid-vapor flows, Pressure drop predictions, Stokes 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.
Pre-requisite(s): ME 521 and ME 522.

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.
Pre-requisite(s): ME 521 and ME 523.

ME5XX Mechanics of Composite Materials:

Unit-1: Nomenclature. Classification of composites. Production techniques. Mechanical properties of fiber and matrix. Fundamental equations of micro-mechanics. Rule of mixtures. Expressions based on theory of elasticity.

Unit-2: Fundamental equations of macro-mechanics. Derivation of elasticity tensor. Elasticity matrix of an anisotropic, transversally isotropic, orthotropic material. Transformation of mechanical properties - material system axes rotation.

Unit-3: Constitutive equation of layered composites. Classical Lamination Theory (CLT). Analysis of symmetric, asymmetric and other characteristic layering setups. Stresses and strains in layered composites.

Unit-4: Thermal stresses in composites. Influence of manufacturing. Failure criteria. Maximum stress/strain criterion. Tsai-Wu criterion. Tsai-Hill criterion, Hashin's criterion. First-ply failure and last-ply failure criteria.

Unit-5: Damage in composites. Fiber breakage. Matrix cracking. Fiber pull out. Delaminations. Repair of composite structures.

Unit-6: Laminated composite plates and shells. Practical case studies or Problem Based Learning (PBL) to enhance application skills.

ME 599 MS Thesis (6)

ME 699 PhD Dissertations (18)



DEPARTMENT OF MANAGEMENT SCIENCES

THRUST AREAS

Engineering Management
Master of Business Administration



Faculty

Muhammad Sabir, HoD	PhD Economics (Vrije University Amsterdam, The Netherlands)
Noor Muhammad	PhD Entrepreneurship (University of Huddersfield, UK)
Cedric Aimal Edwin	PhD CSR (Liverpool Hope University, UK)
Sajjad Nazir	PhD HR (Hohai University, Nanjing, China)
Yousaf Ali Khan	PhD Economics and Management (University of Macerata, Italy)
Kashifullah Khan	PhD Management Sciences, USTC, ANHU, China
Umar Farooq	PhD Industrial and System Engineering Dongguk University, Seoul, South Korea

Personal Assistant

Mr. Noor ul Bashar	B.A University of Peshawar
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HoD

ENGINEERING MANAGEMENT

Globalization has brought new challenges of sustainability, health, environmental protection and a new breed of managers is required by companies and organizations. 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. The primary focus of the program is on management and entrepreneurship to benefit from new and spin off technologies for development of engineering component and product and new venture creation.

Program Educational Objectives

The program aims to produce graduates having knowledge and skills to solve engineering and management problems confronted by industry. They should be able to work and undertake industrial assignments and demonstrate leadership role to help industry, multi-national business and management companies and are capable to work for creation of new business and techno-entrepreneurship.

The program is unique to offer degree having multi-disciplinary approach to integrate technology and innovation to create new opportunities for business and product development. Students having BS degree in engineering disciplines are eligible to apply for the MS program.

Business and Engineering Blend

The Program will:

- Combine professional engineering practice with

core business and management subject.

- The MEM degree offers the practical business perspective needed by technical managers as well as comprehensive quantitative and analytical tools.
- Unlike a traditional MBA program, the MEM Program emphasizes skill specifically requires in technology-based organizations and entrepreneurship.

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.



LIST OF COURSES**Core Courses**

EM501	Engineering Management
EM531	Finance and Accounting for Engineers
EN511	Manufacturing Technology
EN537	Energy Conservation and Management

AREA OF CONCENTRATION**Technical Electives**

EN521/MM581	Industrial Safety
EN561/EM541	Environmental Engineering
EN572/EM513	Thermal and Nuclear Power Plants

Management Electives

EM521	Quality Management
EM522	Operations Management
EM523	Marketing Management
EM524	Entrepreneurship
EM525	Business Plan and Venture Creation

General Electives

EM503	Corporate Governance
EN551/EM502	Sustainable Development

Thesis

EM599	MS Thesis (6)
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COURSE DESCRIPTION

CORE COURSES

EM501 Engineering Management (3-0-3):

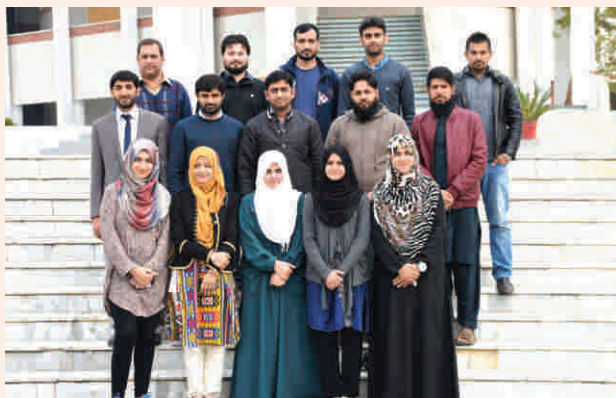
Management principles; Managers and Managing; History of management; Scientific Management; The environment of management; Planning process and strategic management; Managerial decision making; Leadership; Motivation; Organizational communication; Human resources management; Controlling; Promoting innovation and entrepreneurship.

EM531 Finance and Accounting for Engineers (3-0-3):

Financial accounting objectives; Recording business transaction; Measuring business income; The accounting cycle; Measuring the cost of plant assets; Depreciation; Financial statement analysis; Job costing; Process costing; ABC costing; The master budget and responsibility accounting; Time value of money; Capital budgeting.

EN511 Manufacturing Technology (3-0-3):

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.

EN537 Energy Conservation and Management (3-0-3):

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.

TECHNIAL ELECTIVES

EN521/MM581 Industrial Safety (3-0-3): Accidental prevention; Ergonomics and protective equipment; Fire prevention and control; Concept of total loss control.

EN561/EM541 Environmental Engineering (3-0-3):

Combustion & air pollution (ozone, urban smogs, 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 impact analysis; policies and regulations, resource depletion and substitution; three Rs: reduce, reuse & recycle.

EN572/EM513 Thermal and Nuclear Power Plants (3-0-3): 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 energy history and importance; Fission; Fusion & 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.

MANAGEMENT ELECTIVES

EM521 Quality Management (3-0-3): TQM Framework; The Deming Philosophy of TQM; Juran Trilogy; PDCA Cycle; Supplier Partnership; Benchmarking; Quality Management Systems; Quality Function Deployment (QFD); Six Sigma; Total Productive Maintenance; Environmental Management Systems (EMS); ISO 14001 Integrating ISO 14000 with ISO 9000;



Failure Mode and Effect Analysis (FMEA); Products Liability; Experimental Design; t- tests; F Tests; Orthogonal Design; Point and Interval Estimate; Two Factors; Taguchi's Quality Engineering; Orthogonal Arrays; Signal to Noise (S/N) Ratio; Parameter Design; Tolerance Design; Taguchi's Latest thinking.

EM522 Operations Management (3-0-3): 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.

EM523 Marketing Management (3-0-3): Concept and history of marketing; Marketing process; Four Ps; Company analysis; Competitor analysis; Customer analysis; Segmentation; Targeting and Positioning; Product; Services and Branding strategies; Pricing; Integrated marketing communication; Channels of distribution.

EM524 Entrepreneurship (3-0-3): Evolution of entrepreneurship; Entrepreneurship in Pakistan; Sources of capital; Legal structures; How to research for preparing your business plan; Venture capital process; Family businesses and succession planning; Social



entrepreneurs; Ethics and social responsibility & Entrepreneurs; Women entrepreneurs; International Entrepreneurship.

EM525 Business Plan and Venture Creation (3-0-3):

Business Plan Venture; Techno- entrepreneurship; Spin-off technologies; Economics of business; Financial Capital and Outlay, Budget, Costing; 3-Ms Manpower; Material Machine; Leadership and Management; Intellectual Property laws and contracts.

GENERAL ELECTIVES

EM503 Corporate Governance (3-0-3): 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.

EN551/EM502 Sustainable Development (3-0-3):

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 crisis; health; ethics; management for development.

EM599 MS Thesis (6)



MASTER OF BUSINESS ADMINISTRATION

The GIK MBA is designed to provide the optimum conditions for learning through the application of business theory to experience and prepares innovative business leaders who have the capability to face formidable challenges in the current competitive market. We equip our students with the skills to capture value, resources and environment to become entrepreneurs and Intrapreneurs. Our MBA program also focuses on skills to enhance students' research potential and to understand the relationship between theory and practice.

Programme Educational Objectives (PEOs)

The programme will prepare MBA graduates to achieve:

PEO1: Graduating students will have a substantial knowledge and skills to face business challenges and provide professional solutions.

PEO2: To deliver practical and open-ended management experiences to build up graduates who think autonomously and demonstrate innovative leadership and creativity.

PEO3: Provide the skills and knowledge to become entrepreneurs and Intrapreneurs to participate actively in the economic development process of the country.

Programme Learning Outcomes (PLOs)

PLO1: Apply conceptual and analytical skills to solve business problems, both individually and as part of teams using techniques such as case study, project and assignments to bring the relationship between theory and practice.

PLO2: Graduates will have the knowledge to understand the effect of technology on business contexts.

PLO3: To understand the process of innovation and creativity and to bring entrepreneurial changes in organizations.

MBA Degree Nomenclature

i. MBA degree will consist of 69 credit hours consisting 30 credit hours undergraduate and 33 credit hours graduate courses. In addition to that there will be 6 credit hours of research thesis/project.

ii. Candidates having 16 years of relevant education (such as BS Management Sciences, BBA, or two year masters such as M. Com etc.,) will be given 30 credit hours' undergraduate courses exemptions. They have to study 39 credit hours of graduate courses including 6 credit hours of research thesis/project.

iii. Candidates having 16 years of non-relevant education (in any discipline) have to study full 69 credit hours consisting of 30 credit hour undergraduate courses, 33 credit hours of graduate courses and 6 credit hours of research thesis/project. (It also includes MA in various subjects such as Economics, Political Science, etc. Professional qualification (such as ACCA, CIMA will be consider for eligibility only when they have HEC equivalence for 16 years of education and after qualifying the entry test and interview). The candidates who have 2-year bachelor degree are not eligible for GIK Institute MBA program.

iv. For MBA specific (with specialization), students will have to take four elective subjects from one specialization.

v. For general MBA program, students can take four elective subjects from any five specializations.

General Admission Requirements

Admission in MBA program is strictly on the basis of merit. There are no special quotas, reserved seats or admission by donations. Nor is there any arbitrary age limit 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 and race. Beside the basic eligibility based

on earlier education, the candidates must pass written test and interview.

Test (GMAT) and interview are conducted by the institute. International GMAT test score with 600 or above is acceptable, however the candidate have to go through the interview.

Written Test/Interview

Written test similar to Graduate Management Admission

LIST OF COURSES

Undergrad Courses for Non-Business Graduates

Course Code	Course Title
MB511/MS121	Fundamentals of Management
MB512	Business Mathematics and Statistics
MB513/MS151	Introduction to Accounting (Accounting I)
MB514/MS222	Human Resource Management
MB515/MS232	Marketing Management
MB516/MS252	Financial Accounting (Accounting II)
MB517	Business Economics
MB518	Business Finance
MB521/MS231	Principle of Marketing
MB631/MS344	Financial Management

Core courses

Course Code	Course Title
MB632/MB711	Operations and Production Management
MB633/MB712	Financial Reporting and Analysis
MB634	Strategic Marketing
MB635	Contemporary Issues in Management
MB636	Strategic Finance
MB637/MB716	Business Integration and Innovation

Area of Concentration
Finance Electives

Code	Course Title
MB650	Financial Derivatives
MB651	Islamic Banking and Finance
MB652	Finance for Entrepreneurial Ventures
MB653	Advance Corporate Finance
MB654	Behavioural Finance
MB655	Real Estate Investment: Analysis and Financing
MB656	Portfolio Management
MB657	International Financial Markets
MB658	Financial Risk Management
MB659	Management Accounting

Marketing Electives

Code	Course Title
MB660	Service Marketing
MB661	Marketing Segmentation and Positioning
MB662	Social Marketing
MB663	Branding Strategy
MB664	E-Marketing
MB665	Marketing Research
MB666	Consumer Behavior
MB667	Brand Development and Management
MB668	Integrated Marketing and Communication
MB669	International Marketing
MB641	Advertising and Promotion Strategies

Human Resource Management Electives

Code	Course Title
MB671	Recruitment and Selection
MB672	Training and Development
MB673	Compensation Management
MB674	Performance Management
MB675	Appraisal Management
MB676	Decision Making in HR
MB677	Human Relations in Management
MB678	Leadership and Team Management
MB679	Organization Development
MB670/ MB713	Change and Crisis Management

Entrepreneurship Electives

Code	Course Title
MB680	Entrepreneurial Finance
MB681	New Product Development
MB682	Entrepreneurial Marketing
MB683	Technological Entrepreneurship
MB684/EM525	Business Plan and Venture Creation
MB685	Innovation Management in Practice
MB686	Lean Innovation
MB687	Corporate Entrepreneurship
MB688	Small and Medium Enterprises
MB689	Building Business Models

Supply Chain Management Electives

Code	Course Title
MB690	International Supply Chain Management
MB691	Logistics Management
MB692	Transportation Management
MB693	Green Supply Chain Management
MB694	Total Quality Management
MB695	Lean and Six Sigma Management
MB696	Supply Chain Management
MB697	Planning and Control Systems
MB698	Warehousing and Distribution Management
MB699	Procurement Management
MB642	Enterprise Resource Planning (ERP) Systems

Semester-wise Breakdown**Semester 1**

Course Code	Course Title
MB511/MS121	Fundamentals of Management
MB513/MS151	Introduction to Accounting (Accounting I)
MB514/MS222	Human Resource Management
MB517	Business Economics
MB521/MS231	Principle of Marketing

Semester 2

Course Code	Course Title
MB516/MS252	Financial Accounting (Accounting II)
MB518	Business Finance
MB512	Business Mathematics and Statistics
MB631/MS344	Financial Management
MB515/MS232	Marketing Management

Semester 3

Course Code	Course Title
MB632	Operations and Production Management
MB633	Financial Reporting and Analysis
MB634	Strategic Marketing
MB635	Contemporary Issues in Management

Semester 4

Course Code	Course Title
MB636	Strategic Finance
MB637	Business Integration and Innovation
MB638	Research Project
MB6XX	Elective-1

Semester 5

Course Code	Course Title
MB639	Research Project
MB6XX	Elective-2
MB6XX	Elective-3
MB6XX	Elective-4



COURSE DESCRIPTION

UNDERGRADUATE COURSES (for non-business undergrad students)

MB511/MS121 Fundamentals of Management:

Theory and Practice of Management is an introductory course about the management of organizations. It provides guidelines on principles of management that are applicable to all types of enterprises; basic management philosophy and decision making; principles involved in planning, organizing, leading, and controlling; and recent concepts in management. The course contents include general introduction to management, four phases of management including planning, organizing, leading and controlling; global environment; managing change and innovation; human resource management introduction; organizational behavior; power politics, conflict, and stress; leading with influence; communication and information technology; control systems; and operations management. The contents learned in this course will allow students to work effectively with others in an organization. The course will also encourage students to explore the applicability of western management principles and theories in local settings.

MB512 Business Mathematics and Statistics: Perform arithmetic operations. Simple and compound interest. Perform basic calculations of the percentages, averages, commission, brokerage and discount. Solve linear equations in one variable, Matrices, Mathematics of Merchandising, Break-even Analysis, Measures of central tendency. Measures of dispersion and skewness, Line fitting. Time series and Exponential smoothing. Permutations and Combinations. Elementary Probability, Chi-Square, Binomial Distribution, Normal Distributions, estimating from Samples, Hypothesis testing: Chi-Square Distribution.

MB513/MS151 Introduction to Accounting

(Accounting I): The objective of the course is to provide an introductory knowledge of accounting to first-year students from a wide range of disciplines. While a general overview of accounting principles relating to the preparation of financial and managerial reports will be presented, the primary focus is to illuminate how accounting information is utilized by a variety of stakeholders in planning, controlling and investing decisions. Topics include: accounting information in its decision making context, record of accounting transactions, external financial reports, financial statement analysis, cost behavior, determination of product costs, cost-volume-profit analysis, performance management, and budgeting.

MB514 / MS222 Human Resource Management: This course is designed to provide students basic understanding of key HRM functions, designed to help them understand if western human resource management theories and practices have any relevance to local settings. The course will also discuss the Islamic perspective of managing human resource. The students will also be encouraged to compare and contrast the human resource practices suggested in their text books



and the practices critical for achieving success from indigenous perspective. The course contents include human resource planning; strategic human resource management; recruitment and selection; interviewing candidates; training and development; performance appraisal and performance management; career development, retention and voluntary/involuntary turnover; compensation; and global human resource management.

MB515/MS232 Marketing Management: Marketing management course is geared toward providing an understanding of the rationale for marketing decisions from a managerial perspective and the manipulation of marketing mix to achieve business goals. Practically marketing management encompasses activities such as demand creation and Stimulation, positioning, product differentiation, and product and brand management among others. All these activities involve planning, analysis, and decision-making. This course will require the integration of theory and practice. Students will have to make strategic marketing decisions based on analytical techniques they have learned in this course. They will have to devise a marketing plan that is based on a sound conceptual framework, and with a focus on its practical applicability

MB516/MS252 Financial Accounting (Accounting II): This introductory course in financial accounting is for students having no or limited prior accounting knowledge and provides an understanding of how financial statements are prepared for various types of organizations. The course is designed to provide and create an understanding of basic financial terminologies and concepts, to familiarize with the accounting process of determination of income/ loss for a certain period and financial position at a certain date, to develop an understanding of the accounting cycle and the key valuation and allocation methods used for the assets side of balance sheet.

MB517 Business Economics: The objectives of this course is to introduce the student to the fundamentals of micro and macro-economic theory and practice as they are applied to business in a managerial context. Provide the student with the basic analytical skills, insights and managerial decision-making tools required for sound business decisions. Explain the forces that shape the external environment of the firm such as aggregate demand, economic cycles, inflation, interest rates, exchange rates, and the role that demand management policies play in the economy and their impact on the firm's operations. Applies economic theory and methodology to business problems. Topics include demand analysis, determination of cost, pricing and profitability. Marketing and sales forecasting techniques are also introduced briefly.

MB518 Business Finance: This course is designed to provide an introductory framework for understanding how financiers think, how they break down components of a financial problem, and how they make decisions as investors and corporations in the financial market. By the end of this course, you should be familiar with financial vocabulary, understand aspects of financial theory, develop skills in financial computation, and appreciate the underlying financial mindset as well as incentives involved when solving problems of finance. Students will learn how to determine risk, how to make decisions, and how to value an investment as a potential financial opportunity.

MB521/MS231 Principles of Marketing: This course will focus on developing an understanding of key marketing concepts aimed at improving the conceptual knowledge of marketing as applicable to decision making process with a focus on tactical marketing mix decisions. Further, it will provide the student with a comprehensive framework to evaluate marketing decisions and to create successful marketing initiatives. The contents included in the course would be definition,

evolution and future of marketing, marketing strategy and elements of marketing mix, elements and analysis of marketing environment, ethics and social marketing, strategic marketing planning, sales forecasting, and designing marketing plan.

MB631/MS344 Financial Management: Financial Management course aims at imparting knowledge about the fundamental concepts and tools of financial management. It emphasizes the importance of financial management skills to individuals and enterprises. You are expected to gain an initial understanding of the finance function in an organization, the role of the finance manager and the financial environment in which the firm operates. The financial environment covers the understanding of financial and capital markets along with the broad orientation of macroeconomic factors affecting the business. The emphasis will remain on developing the skills for planning, appraising and evaluating the investment, financing and operating decisions.

CORE GRADUATE COURSES OF MBA

MB632/MB711 Operations and Production Management: This course is designed to provide the student with an understanding of the foundations of the operations function in both manufacturing and services. The course will analyse operations from both the strategic and operational perspectives and highlight the competitive advantages that operations can provide for the organization. The goal of the course is to help students become effective managers in today's competitive, global environment. The course will examine operations as a competitive weapon, demand forecasting, supply-chain management, aggregate planning, inventory systems, just-in-time systems and material requirements planning.

MB633/MB712 Financial Reporting and Analysis:

The major source of data for economic decisions made by the stakeholders is the financial statements. The objective of the course is to create competency of reading and understanding the financial statements. The jargons and terminology of each discipline has special connotation and if misunderstood it can lead to faulty decisions if not blunders. Accounting is no exception. For appropriate analysis proper understanding of different terms used in financial reporting is of utmost importance. The course traces the historical development of financial reporting. Once competence of understanding is developed the course deals with the analysis of financial statements. For proper analysis one needs to determine the quality of financial statements. The course develops the tools to determine the quality of financial statements.

MB634 Strategic Marketing: Strategic Marketing Management is an advance level Marketing course. The aim of the course is to develop a strategic thinking approach to marketing. It aims to help students understand how companies compete using marketing strategy and its correlates focusing on achieving a competitive advantage for the firm by creating customer value and leveraging the firm's marketing resources in



the most efficient and effective manners. It builds upon the basic concepts of Marketing, which the students have learned in their previous marketing courses and to prepare students to grasp the complex issues of specialized courses like Business policy, etc. In this course students are exposed to a dynamic world of marketing activities using a number of approaches and to enable the students to understand the practical issues that are critical to develop performance orientation. Principles, concepts and analytical tools are taught employing real life examples from both Pakistan's and international corporate world. This will enable the students to develop skills and competency to apply analytical tools and develop appropriate strategic marketing plans and manage its implementations. After taking this course student are better equipped, both mentally and academically; they understand various terms and concepts and understand how and when to apply them. It prepares them to take on the real life challenges and to add value to the organization for which they will work.

MB635 Contemporary Issues in Management: This course teaches students an understanding of the challenges faced by management professionals in a complex, dynamic and increasingly risky business environment. This course exposes students to the controversies and dilemmas of contemporary management thinking and practice. It builds on learning undertaken in Levels 1 and 2, enabling students to work towards advanced level of critical awareness necessary for a successful career in 21st-century management. Contemporary Issues in Management synthesises cutting-edge conceptual discussion and hones the students' diagnostic, analytical and communication skills for effective human interaction and decision making.

MB636/MB715 Strategic Finance: The aim of this course is to examine the theoretical underpinnings of corporate finance and see how they are applied. The

material is a continuation of what was taught in the first year Financial Management course. There will be more emphasis on "how corporate financing is really done ". The emphasis of Financial Management course was on skill development while this course emphasis is on theoretical and conceptual understanding of financial management function and its application in real life scenario.

MB637/MB716 Business Integration and Innovation: The course aims to equip management students with an understanding of the main issues in the management of business integration and innovation and an appreciation of the relevant skills needed to manage innovation and integration of business at both strategic and operational levels. It provides evidence of different approaches based on real-world examples and experiences of leading organisations from around the world. The management of innovation is one of the most important and challenging aspects of modern organisations. Innovation is a fundamental driver of competitiveness and it plays a large part in improving quality of life. Innovation, and particularly technological innovation, is inherently difficult, uncertain and risky, and most new technologies fail to be translated into successful products and services. Given this, it is essential that students understand the strategies, tools and techniques for managing innovation, which often requires a different set of management knowledge and skills from those employed in everyday business administration.

SPECIALIZATION ELECTIVES IN FINANCE

MB650 Financial Derivatives: The purpose of this course is to provide the student with the necessary skills to value and to employ options, futures, and related financial contracts. In order to provide a useful treatment of these topics in an environment that is changing rather rapidly, it is necessary to stress the fundamentals and to

explore the topics at a technical level. The topics that will be covered include the valuation of futures contracts on stock indices, on commodities and Treasury instruments; the valuation of options, empirical evidence, strategies with respect to these assets, dynamic asset allocation strategies, or which portfolio insurance is an example, swaps, and the use (and misuse) of derivatives in the context of corporate applications. One-third of the course will be devoted to futures, a third to options, and a third to their applications. Many of the applications will be sprinkled along with the coverage of futures and options.

MB651 Islamic Banking and Finance: This course introduces the concept of economic behaviors of a society that adheres to the Islamic doctrine; economic properties of an Islamic economy, general equilibrium and macroeconomic policies in Islamic economies, Islamic banks and finance and the role of the stock exchange in an Islamic economy. Other topics include basic differences between Islamic banks and conventional banks; financial instruments of Islamic banks; profit/loss sharing method of finance is compared with fixed interest charges. The relationship between Islamic financial institutions and the Central Bank is analyzed.

MB652 Financing for Entrepreneurial Ventures: The focus of this course is to analyse the unique financial issues which face entrepreneurial firms and to develop a set of skills that has wide applications for such situations. The course covers venture capital industry and its players, sources of financing, legal aspects of venture capital, cost of capital and valuation, investment feasibility and comparable analysis, real options, and game theory. This course covers the finance of technological innovation, with a focus on the valuation tools useful in the venture capital industry. These tools include the "venture capital method," comparable analysis, discounted cash flow analysis, contingent-

claims analysis, and real options. The primary audience for this course is finance majors interested in careers in venture capital or in R&D-intensive companies in health care or information technology.

MB653 Advanced Corporate Finance: The objective of this course is to study the major decision-making areas of managerial finance and some selected topics in financial theory. The course reviews the theory and empirical evidence related to the investment and financing policies of the firm and attempts to develop decision-making ability in these areas. This course serves as an extension of corporate finance course. Some areas of financial management may include leasing, mergers and acquisitions, corporate reorganizations, financial planning, and working capital management, and some other selected topics. Other areas that are covered in corporate finance are covered more in depth and more rigorously. These include investment decision making under uncertainty, cost of capital, capital structure, pricing of selected financial instruments and corporate liabilities, and dividend policy.

MB654 Behavioural Finance: There is an abundance of evidence suggesting that the standard economic paradigm - rational agents in an efficient market - does not adequately describe behavior in financial markets. In this course, we will survey the evidence and use psychology to guide alternative theories of financial markets. Along the way, we will address the standard argument that smart, profit-seeking agents can correct any distortions caused by irrational investors. Further, we will examine more closely the preferences and trading decisions of individual investors. We will argue that their systematic biases can aggregate into observed market inefficiencies. The second half of the course extends the analysis to corporate decision making. We then explore the evidence for both views in the context of capital structure, investment, dividend, and merger decisions.

MB655 Real Estate Investment: Analysis and Financing:

This course provides an introduction to real estate with a focus on investment and financing issues. Project evaluation, financing strategies, investment decision making and real estate capital markets are covered. No prior knowledge of the industry is required, but students are expected to rapidly acquire a working knowledge of real estate markets. Classes are conducted in a standard lecture format with discussion required. The course contains cases that help students evaluate the impact of more complex financing and capital markets tools used in real estate.

MB656 Portfolio Management:

This course covers various topics related to portfolio management. Topics include diversification and portfolio theory, capital market theory, security selection and bond selection; portfolio management: revision of equity portfolio and fixed-income portfolio, risk management with derivative securities, performance evaluation, and portfolio manager's duties and responsibilities; integrating derivative assets and portfolio management.

The objective of the course is to study theory and empirical evidence relevant for portfolio management. An emphasis is placed on understanding how an investment professional would allocate funds in a

hypothetical portfolio. Major topics include estimation of capital market parameters, trade-off between risk and return, optimal portfolio selection, equilibrium asset pricing models, and delegated portfolio management. Emphasis will be put on development of techniques that should be part of the tool kit of those interested in becoming professional investors and/or researchers in finance. The course material is tilted heavily towards equity markets since there are separate courses that cover fixed income markets and derivative securities. This course is designed to primarily address the needs of advanced students in an MBA program.

MB657 International Financial Markets:

This course covers contents related to international financial markets and exchange rates. Topics include pricing in the foreign currency and Eurocurrency markets, use of forward exchange for hedging, short-term returns and market efficiency in the international money markets, foreign currency options, international capital asset pricing, pricing of foreign currency bonds, currency swaps, Eurocurrency syndicated loans, foreign currency financing and exposure management.

MB658 Financial Risk Management:

Risk is costly. This statement is absolutely agreed by businessmen and professionals, particularly those facing inherent risk in their professional lives. Minimizing the cost of risk to an optimum level unanimously means that we are increasing the value of a firm. However, the cost of risk minimization, albeit its ease to say or learn conceptually is very much difficult to implement, either by self-managed method or by risk-transfer approach. If a business executive decides to manage the cost of risk herself, she has to estimate direct and indirect costs pertaining to the possibly risky events or occurrences. On the other hand, if executive transfers the risk to a third party, she has to load in insurance premium as the compensation for the insurer, comprising administrative fees and the insurer's business return.



MB659 Management Accounting: This course explores the fundamental concepts of managerial accounting. It will enhance the students' business concepts and methods used to report managerial performance information to internal users and managers to assist in making sound business decisions in managing the firm. Students will augment their ability of collection, analysis, and communication of quantitative and non-quantitative information.

SPECIALIZATION ELECTIVES IN MARKETING

MB660 Service Marketing: Students examine the important issues facing service providers and the successful implementation of a customer focus in service-based businesses. Topics include an overview of services marketing; understanding the customer in services marketing; standardizing and aligning the delivery of services; the people who deliver and perform services; managing demand and capacity; and promotion and pricing strategies in services marketing.

MB661 Marketing Segmentation, Targeting and Positioning: Behind any successful marketing campaign there is a careful segmentation, targeting and positioning activity. In fact, the precise identification of potential customers enables cost optimization and sales and profit increase. Further, a correct differentiation and positioning approach makes it possible to acquire a decisive competitive advantage over the competition. In order for this to happen, it is necessary to understand and adequately employ the most modern techniques that you will learn with this course.

MB662 Social Marketing: The course is based on the use of marketing principles to develop social marketing strategies and programs and to bring behavioral change for a social good. Social marketing can be used to promote merit goods, or to make a society to avoid demerit goods and thus promoting well-being of

society. It can influence behavior in four different ways according to Kotler & Lee (2012): 1) accept a new behavior 2) reject a potentially undesired behavior, 3) modify a current behavior 4) abandon an old undesired behavior. We will follow the proposed structure and learn how to apply key marketing principles to campaigns and efforts to improve health, decrease injuries, protect the environment, build communities, and enhance financial well-being

MB663 Branding Strategy: Effective brand management is the key to developing product and communication strategies which lead to marketing success. This course is designed to develop the necessary knowledge and skills for creating and managing brands which resonate with customers and allow the marketing organization to build and maintain a loyal and profitable customer base. A range of branding theories, concepts, strategies and practices designed to build, measure and sustain brand equity will be addressed across a range of real world contexts, product types and industries.

MB664 E-Marketing: This course will provide students with an overview of the application of marketing strategy using the Internet. Topics include the basics of designing a web site for content and functionality, using the web to service and cultivate customers, web advertising and sales promotion tools, e-commerce success factors and trends in web marketing. Students will apply theory using case examples and will become familiar with analyzing web metrics to measure the success of programs.

MB665 Marketing Research: This course starts emphasis on the role of marketing research with a deep insight into why and how marketing research is important to an organization. It describes various steps in marketing research process and characteristics of successful marketing research. It also includes, types of

marketing research, nature of marketing research problems, types and sources of data in marketing research, types of research design and their applications in specific situations keeping in view the importance of research design in marketing research. Additional topics includes: classification of descriptive research, aspects of causal research, experimental design, various kinds of rating scales with physical configuration of scales, reliability and types of reliability, details of sampling, sampling frame, sample size and factors affecting sample size, sampling techniques with application in specific situations, sampling errors, process of questionnaire development, data collection and fieldwork. It also include some statistical topics such as data analysis, data preparation, data cleaning, descriptive and inferential statistics, hypotheses testing, statistical correlation, regression analysis, analysis of variance (ANOVA) etc. have been elaborated in detail. Finally knowledge is imparted regarding report writing, its importance and components of research report in this course.

MB666 Consumer Behavior: Consumer Behaviour (CB) is a course designed to enhance students understanding of how and why consumers purchase (or do not



purchase) goods and services. It will combine both the theoretical concepts of consumer behavior and its application for marketing strategies related to private, public and non-profit sections. At the conceptual level it will seek to present and integrated framework around which major areas of consumer behavior can be understood and applied. This course will explore and identify market identities and various sources of influence with the way consumers think and learn from market related information. The knowledge and understanding gained from this course can be utilized in the market place to make rational decisions to satisfy consumer needs and wants and remain loyal to products.

MB667 Brand Development and Management

Students explore the issues and challenges commonly faced by brand managers. Topics include an introduction to brands and brand management, identifying and establishing brand positioning and values, planning and implementing brand marketing programs, measuring and interpreting brand equity, and growing and sustaining brand equity

MB668 Integrated Marketing Communication: This course is designed to develop an understanding about the role of communications in the marketing mix. The course covers different types of promotional tools, media and methodologies of integrated marketing communication process. Students will learn an analytical approach to the study of marketing communications including how to integrate all of the marketing communication elements and how this is critical to an organization's success.

MB669 International Marketing: Students explore all aspects of marketing from a global perspective to better respond to international opportunities and competitive situations. Topics include an overview of international marketing; social, cultural, political, and legal environments; international market-entry opportunities;

planning and managing market entry strategies and products; global distribution and pricing; international promotion, sales, and negotiation; and international market planning.

MB641 Advertising and Promotion Strategies:

Advertising and Promotion management is designed as an introduction to the field of integrated marketing communications. The emphasis is on the use of communication to meet marketing objectives, including but not limited to advertising. This course will provide a broad overview of many areas that pertain to marketing communication. Special attention will be placed on understanding the consumer in order to communicate better. Although creative issues will be examined, this is primarily a management, not a creative, course.

SPECIALIZATION ELECTIVES IN HUMAN RESOURCE MANAGEMENT

MB671 Recruitment and Selection: This course will provide a conceptual and operational understanding of the key aspects of human resources staffing functions, including job analysis, recruitment, assessment, selection, and performance evaluation. At the completion of this course, students should be able to design and implement an effective and legally defensible staffing system tailored to organizational requirements. They should also be able to evaluate existing staffing programs for efficaciousness and legal compliance.

MB672 Training and Development: Training and development in organizations is usually defined as planned activities directed at enhancing the learning of job-relevant knowledge, skills and attitudes by members or employees of the organization. Almost invariably, the goal is to improve on-the-job performance so as to enhance the overall effectiveness of the organization and/or to increase the likelihood that organizational goals will be reached. This course will familiarize students

with the training and development function.

MB673 Compensation Management: Compensation and reward systems are key contributors to organizational effectiveness. In this course students will learn how such systems operate to attract, retain and motivate a competent workforce. Further students will gain an understanding of how to assess reward systems in terms of the criteria of equity and cost effectiveness and how to assess and diagnose compensation management issues and problems and develop appropriate solutions. Much of the course revolves around application of principles to a case where students design all aspects of a compensation plan. In other words, this case study simulates designing a pay structure, determining a competitive pay level based on salary survey data, determining individual pay rates, and budgeting/costing and administering the compensation program of an organization.

MB674 Performance Management: This course examines the importance of an effective performance management system in helping organizations define and achieve short and long term goals. It explains and reinforces the concept that performance management is not a one-time supervisory event, but an ongoing process of planning, facilitating, assessing, and improving individual and organizational performance. In addition, the course emphasizes the importance of measuring the effectiveness of human resource activities that are designed to enhance individual and organizational performance.

MB675 Appraisal Management: This course is designed to assist professionals or managers in giving effective performance appraisals that help motivate employees to achieve higher productivity. Performance appraisals often raise the anxiety levels of both managers and employees alike. Thus, special emphasis will be placed on how to prepare for and conduct

performance discussions that are objective, complete, and defensible. Students will share experiences and participate in various exercises to ensure that they fully understand ways to get the best possible performance from employees.

MB676 Decision Making in HR: The aim of this course is to improve decision-making skills and to provide strategies for further improvement in the future. We cover how individuals and groups make decisions and solve problems, individually and in organisations. By the end of the course, students will understand their own decision styles and personal dispositions, make decisions more deliberately and systematically, and will be able to use decision analysis techniques and group processes, integrate their values into their decisions, and

generally, have increased confidence in their decision-making.

MB677 Human Relations in Management: This course build and nurture effective human relation skills in personality. The students experienced personal growth, increased self-awareness, and the development of human relations skills through classroom assignments, exercises, and projects. Students will be able to describe models of organizational behavior, social systems and organizational culture, explain the performance appraisal process and importance of demonstrate communications management techniques, describe employee attitudes and their effects, explain the importance of inter, intra and leadership skills and why they are so important in an organization, engage in



collaborative learning, team building, and skill-building exercises and case studies; explain the concept of equal employment opportunity, discuss stress reduction and counseling techniques.

MB678 Leadership and Team Management: Some of the topics that this course should include: concept of leadership, trait theories, behavioral theories, situational theory, contingency theories, types of leadership (charismatic leadership, transactional leadership etc.), power, empowerment, communication, organizational communication, group dynamics, understanding work team, building teams, team based organization, decision making, group decision making, effective team communication, conflict and negotiation, learning organizations, reward system, managing virtual teams, effective team meetings, strategic leadership, change Management, ethics in leadership, looking at future: what next, teamwork: learning from the nature.

MB679 Organization Development: Organizational Development (OD) is a conscious, planned process of developing an organization's capabilities so that it can attain and sustain an optimum level of performance as measured by efficiency, effectiveness, and health. Some topics of the course includes: The challenge for organizations, OD: a unique change strategy, what an "ideal" effective, healthy organization would look like? the evolution of od, the organization culture, the nature of planned change, action research model, general model of planned change, the organization development practitioner, creating a climate for change, od practitioner skills and activities, professional values, entering and contracting, diagnosing organizations, organization as open systems, diagnosing organizations, diagnosing groups and jobs, collecting and analyzing diagnostic information, designing interventions, leading and managing change, evaluating and institutionalizing organization development interventions, interpersonal and group process approaches, organization process

approaches, restructuring organizations, employee involvement, work design, performance management, developing and assisting members, organization and environment relationships, organization transformation, the behavioral approach, seven practices of successful organizations

MB670/MB713 Change and Crisis Management:

Organisations move through a number of identifiable stages as they grow and develop. In some cases these changes are planned, in others they are unplanned (crisis). Sometimes the forces for change come from within the organisations and at other times they will be caused by external forces or influences. The need for organisations to meet and to cope with changing and crisis conditions requires innovation, creativity and flexibility. This course will help develop the skills and knowledge required to promote the use and implementation of innovative work practices to effect change and manage changes so there is minimal work place disruption. Some of the important topic includes: Benefits & Significance of Change Management, Change management models and its implications (such as Kurt Lewin model), transactional vs transformational leadership, theories of change and evaluations in organisations (such as life cycle theory, teleological



theories of change, dialectical theories of change etc), Other topics includes cyber security, supply chain, terrorism, pandemic, DR trends, emergency response, leadership, data breach, communications, news media, social media — from the experts involved with these efforts. It also examine strategies for job and career improvement. The course also discuss the tools, knowledge, and understanding to benchmark, assess, and improve your business continuity, disaster recovery, and crisis management program. Some topic includes: overview of crisis management, definitions, abbreviations and dimensions of crisis management, difference between conflict and crisis, levels, types and causes of crises, system, concept/ types of system, analysis, decision, what affects decision making? , decision making at different level, research need, skills, sequence, main types, classifications and design, crises management, basis of decision making during crises, practical steps in crises management, a suggested model for crises management, suggestions for different levels, pre-emptive measures for crises management, case studies on crises management.

SPECIALIZATION ELECTIVES IN ENTREPRENEURSHIP

MB680 Entrepreneurial Finance: This course differs from a typical corporate finance course in that it highlights the special and unique considerations when planning the financial needs of new ventures and young companies. Many typical avenues of funding (such as bank borrowing, issuing of bonds or issuing of liquid equities) for established or public listed companies are not accessible to small and young companies due to the lack of business track record. The analyses and requirements of investors who are considering providing finances to small and young companies may also be different from that of public equity investments. This course will provide students with the understanding of various aspects and processes in financial planning and financial management of new ventures or young

companies, as well as investment analyses and considerations for investors providing funding to such companies.

MB681 New Product Development: Product Design and Development is a project-based course that covers modern tools and methods for product design and development. The cornerstone is a project in which teams of management, engineering, and industrial design students conceive, design and prototype a physical product. Class sessions are conducted in workshop mode and employ cases and hands-on exercises to reinforce the key ideas. Topics include identifying customer needs, concept generation, product architecture, industrial design, and design-for-manufacturing.

MB682 Entrepreneurial Marketing: This module provides an in-depth understanding of marketing theory, concepts and tools used to market a new product offering and/or applicable in an entrepreneurial setting. Emphasis is placed on the special requirements for creating and executing marketing plans and programmes in a setting of rapid technological change. Although many of the cases are technology oriented, the



principles involved are generally applicable to entrepreneurial ventures. The course is organized around three major themes: (1) Identification of suitable markets, communities and/or partners to which your product offering will provide stakeholder value; (2) Strategies for market reach and network engagement with early adopters and the wider market, both of which are vital for commercial viability and sustainability in settings of rapid technological change; (3) Successful implementation of a marketing strategy in an entrepreneurial setting.

MB683 Technological Entrepreneurship: This course focuses on technology entrepreneurs and their new ventures. It helps the student who is majoring in science, engineering, or other non-business disciplines to understand key aspects of entrepreneurship and the formation of new technology companies so that you can decide if a technology business path is right for you. Major class topics include learning to identify and evaluate innovation opportunities, assessing an industry, intellectual property strategies, the founding team, business models, and funding a new venture.

MB684/EM525 Business Plan and New Venture Creation: The course seeks to help students to develop a greater awareness of their personal goals, motivations, strengths and limitations in the context of venture creation and growth, particularly in the context of forming new ventures or joining a new young venture. It aims to enhance their understanding of the role of the entrepreneur in the new venture creation process and to develop their capabilities to recognize, assess and articulate new venture opportunities. In addition to providing students with a solid grounding regarding management thinking on entrepreneurship and new venture creation the course also provides the opportunity to apply this knowledge in practice. The course requires students to work in groups to create a coherent and viable business concept or plan which will

be presented to an external panel in the last class session. Students will have opportunities to learn from each other, from practitioners in the field and from the latest theories/concepts on the topic. Interactive lecture sessions will be complemented by contributions from guest speakers who will be important to student learning by providing first-hand experience of the issues associated with pursuing entrepreneurial opportunities. Whilst the frameworks and concepts learned are applicable in a start-up venture situation, most are as applicable when identifying and developing new activities within a larger organizational setting.

MB685 Innovation Management in Practice: The course aims to enhance the students' knowledge on the practice of innovation through exposing the students to the 'messiness' of innovation problems in a real setting. The students will have to apply their knowledge of theories, concepts and frameworks of innovation management that they have been exposed to in the first semester to solve a real innovation challenge. Students will also develop their capabilities to recognize, assess and evaluate innovation problems and to articulate and deliver appropriate solutions. The course will also provide a higher awareness of the role that the context plays in tackling innovation problems. The innovation challenge projects will be defined around a specific innovation problem and will be defined together with a



client. The innovation challenge will have to be broad enough to allow the students the ability to explore different access of the innovation process, but also narrow enough to lend itself to exploration within the 10 weeks within the knowledge and capabilities of the teams and within the scope of the course.

MB686 Lean Innovation: Explores how corporate venturing and entrepreneurial teams can quickly and effectively bring new concepts to market. Demonstrates how small technical teams can quickly investigate opportunity spaces, develop and select concepts, and translate these into prototypes. Other topics include industrial design thinking, project teams, prototyping, and commercialization of design. Explores the challenges and solutions to managing a technology-based product within an established corporation and details frameworks on how innovative projects can be inexpensively tested and deployed within the organization.

MB687 Corporate Entrepreneurship: This course focuses on the processes by which teams within an established company conceive, foster, launch, and manage a new business that is distinct from the parent



company. Following the market development lifecycle the course will examine the management of eight types of innovation: disruptive, application, product, process, experiential, marketing, business model, and structural.

MB688 Small and Medium Enterprises: This subject creates knowledge and analytical skills through applied research and involvement in the process of managing a small and medium enterprise venture in the contemporary business environment. Students collaborate with selected industry practitioners on an industry-based research project. This enables students to acquire the basic competencies necessary for entry into a career in new venture/small and medium business management. Students learn to appreciate the major ingredients in small and medium enterprise success, and the special problems small and medium enterprises may encounter.

MB689 Building Business Models: An innovative product may be a feat of engineering, but that does not automatically turn it into a commercial success. What makes the difference between success in the lab and success in the marketplace is the business model. How will you create and deliver value for your customers? How will you extract some of that value for your organization? The business model encompasses your product or service, your customers, and the economic engine that will enable you to meet your profitability and growth objectives. Business model analysis is important for startups, new and established businesses which need to discover, defend or evolve their business models. This course introduces a structured way to think about, analyze, and develop a sound business model.

SPECIALIZATION ELECTIVES IN SUPPLY CHAIN MANAGEMENT

MB690 International Supply Chain Management: To apply world-class tools and techniques used to operate

efficient and effective Global Supply Chains. The goal is to learn how to manage Supply Chain strategies that support overall corporate objectives. By the end of this course, the student will be able to understand Supply Chain Management from a global, multi-dimensional perspective. Students will be able to analyze a company's strategic focus, its customer demand profiles, and its core competencies in order to design a supply chain that supports its business model. This includes understanding global supplier capabilities (i.e. capacity, inventory management and quality) and the logistics systems that deliver goods to domestic and international markets.

MB691 Logistics Management: Logistics and distribution are core components of supply chain management. Logistics management plans, implements, and controls efficient, effective forward and backward flow and storage of goods and services. It also predicts and circulates timely related information between the point of origin and the points of production, purchase and consumption in order to meet customers' requirements. Logistics decisions are typically classified into: 1) strategic: dealing with decisions that have a long-lasting effect on the firm; 2) tactical: including decisions that are updated anywhere between once every quarter and once every year; 3) operational: referring to day-to-day decisions. For this course, the focus will be on strategic and tactical decisions in logistics management.



MB692 Transportation Management: The goal of this course is for students to understand the basic modes of transportation, the economic fundamentals underlying each and some of the ways in which today's supply chain manager can use them to achieve improved efficiencies and cost effectiveness.

MB693 Green Supply Chain Management: Green supply chain management is a modern concept of management practices attempting to integrate environmental concerns to all stages up and down the supply chain. In a globalised market, the environmental performance criteria extend beyond the single firm to its entire supply chain network across national borders. Topics covered will include closed-loop supply chains; reverse logistics systems; carbon foot printing; water foot printing; life-cycle analysis; and supply chain sustainability strategy.

MB694/EM521 Total Quality Management: Total Quality Management (TQM) is a scientific approach for management and employees to be involved in the continuous improvement of processes underlying the production of goods and services. This approach is fundamental in business, industry, evidence-based medicine and many other disciplines.

Students who complete this course will be able to critically appraise management techniques, choose appropriate statistical techniques for improving processes and write reports to management describing processes and recommending ways to improve them. People need to be aware of what they can and can't do with data. Management is limited to what it knows and so too is the organization. Awareness of statistical techniques and their use is paramount to collecting information and making decisions. Quantitative skills are necessary in order to make decisions - else you are just another person with an opinion.

MB695 Lean and Six Sigma Management: In addition

to covering the fundamentals of Lean and Six Sigma, this course will equip students with other important tools and strategies to improve the performance of business processes. Students will practice solving business problems and improving processes through case studies, team exercises and simulations, self-assessments, and guest lectures. Topics covered will include: overview of quality management; philosophies of quality management; project quality management; quality planning for inputs, tools and outputs; quality assurance, quality control mechanisms; statistical techniques for assessing quality; analysis of contract management systems; normal and premature project close out; six sigma improvement methodology and tools, lean manufacturing tools and approaches, dashboards and other business improvement techniques. Students will also gain an understanding of the strategic importance of business improvement, the need for fact based management, the significance of change management, and how to deploy these tools in different parts of the value chain.

MB696 Supply Chain Management: 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 and Logistics Management. This subject also develops student's communication skills and ability to analyze and consolidate complex information.

MB697 Planning and Control Systems: This course includes the design and management of planning and control systems within the organization and across the supply chain. It covers business planning; master production scheduling; material requirements planning; just-in-time and theory of constraints, Enterprise resource planning (ERP) and business-to-business (B2B) systems; impact of information technologies on planning and control systems.



MB698 Warehousing and Distribution Management:

This course provides an understanding of the concepts and theories that drive the effective management of an organization's warehousing and distribution systems. The course will cover topics that include Warehousing Layout, Design & Configuration, Receiving, Delivery, Material Storage, as well as Distribution strategies, Distribution Network planning, Distribution ERP systems (WMS) and Cross docking.

MB699 Procurement Management: The course will explore the central concepts of organizational procurement and its interface with other areas of an organization. It will provide opportunities to examine issues such as organizational procurement process, supplier selection process, supplier management and other strategic issues. Topics to be covered in the course are: fundamentals of public procurement, tendering and contracting procedures, monitoring and evaluation, procurement planning, bidding documents, bidding procedures, bid opening and evaluation procedures, methods of procurement, project cycle management, ethical considerations in procurement, fraud detection

and control, contract management, and legal aspects of procurement.

MB642 Enterprise Resource Planning (ERP) Systems:

This course will introduce you to enterprise systems and show how organizations use enterprise systems to run their operations more efficiently and effectively. You will learn about the critical success factors and implementation strategies that lead to enterprise system success, and about the informational, knowledge, and decision-making opportunities afforded by enterprise systems.

The course will examine typical Enterprise Systems modules: materials management (MM), supply chain management (SCM), customer relationship management (CRM), financials, projects and human resource management (HRM). Enterprise systems use a single database to integrate business transactions along and between processes, leading to benefits such as efficient and error-free workflows plus accounting, management reporting and improved decision-making. The course will incorporate a laboratory component using SAP software.





ENERGY SYSTEMS ENGINEERING

(INTER FACULTY PROGRAM)



ENERGY SYSTEMS ENGINEERING

In today's modern world, the ever growing energy demand and its efficient use requires professional in Energy Systems who can provide solutions for effective utilization of energy by integrating available sources of energy. The program will focus on energy utilization techniques, research and management. The global energy industry faces growing demand to discover ways to extract, process, use energy sources more efficiently and to develop economic yet cleaner technologies. Such development of environment friendly and economically efficient Energy Systems requires professionals with a new mix of technological skills and critical thinking in use of traditional fossil fuels, renewable energy and energy materials.

Energy Systems utilize primary energy forms to accomplish the desired tasks. From industrial applications to the transportation that allows mobility of people and goods throughout the world, Energy Systems are the common thread that transforms primary energy sources to achieve useful work. This program will help the students to play an important role in understanding and resolving environmental issues such as indoor and outdoor air quality, industrial pollution and global warming. Considering the demand of industry, the graduates are expected to meet the challenges of developing, deploying, operating, and maintaining Energy Systems.

Graduate Program

The graduate program in Energy Systems Engineering at GIK Institute is a blend of courses from Mechanical, Materials and Electronic engineering. It is designed in such a way that the graduate students enrolled in this program will gain an in-depth knowledge of subject areas in energy systems engineering as well as relevant environmental, economic and regulatory issues.

Program Outcome

The graduates are expected to serve and contribute in interdisciplinary teams of experts particularly in the field of energy and industrial sectors. They will provide solutions to solve energy related problems in both public and private sector organizations utilizing their knowledge, design and research experience.

Graduate Profile

The graduates should demonstrate knowledge in field of energy, engineering principles, communications skills and professional ethics.

Course Work

The Interfaculty MS degree program in Energy Systems Engineering is based on 7 - 8 courses from the core and elective courses listed below. At least three courses are mandatory from the core courses, while remaining can be selected based on the field of specialization in research topic for MS thesis. One 400 level course may be allowed on the recommendation of the supervisor.



Core Courses:

EN537	Energy Conservation and Management
EN538	Energy Conversion and Utilization
EN541	Instrumentation and Control Systems
EN561	Environmental Engineering
EN571	Energy Materials

ELECTIVE COURSES:**Materials Engineering**

EN562	Fuel and Clean Technology
EN572	Thermal and Nuclear Power Plants
EN573	Hydrogen Storage Materials
EN574	Nanotechnology in Energy
EN581	Solar and Fuel Cells Technology

Electrical and Electronic Engineering

EN511	Transmission and Distribution of Electric Energy
EN515	Adjustable Speed Drives
EN516	Photovoltaic Energy and its Applications
EN517	Electronics for Energy Control
EN643	Advanced Process Control

Mechanical Engineering

EN531	Thermodynamics and Heat Transfer
EN535	Air conditioning and Refrigeration
EN536	Internal Combustion Engines
EN594	Renewable Energy
EN595	Solar Energy Utilization

General and Management Electives

EN521	Industrial Safety
EN551	Sustainable Development
EN552	Energy Economics

COURSE DESCRIPTION

CORE COURSES

EN537 Energy Conservation and Management (3-0-3): 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.

EN538 Energy Conversion and Utilization (3-0-3): Fuels and combustion. Steam, Gas and combined cycle power plants. Turbines, pumps, boilers and condensers. Renewable energy resources. Efficiency improvement of thermal power plants. Energy Storage. Energy and its impact on the environment.

EN541 Instrumentation and Control Systems (3-0-3): Typical sensors and signal conditioning, Force and torque measurement, Data acquisition systems, Fluid pressure measurements, Fluid flow measurements, Temperature measurement. Introduction to linear time invariant control system, Classical and Modern control system, Analysis and design in time and frequency domains.



EN561 Environmental Engineering (3-0-3):

Combustion & air pollution (ozone, urban smogs, 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 impact analysis, policies and regulations, resource depletion and substitution, three Rs: reduce, reuse & recycle.

EN571 Energy Materials (3-0-3): Electrical, thermal, mechanical, chemical, magnetic and optical, properties of material, Materials for photovoltaics, High temperature functional materials devices and coatings, Refractory & other materials, High temperature instrumentation, Clean tech. materials, Materials for nuclear power plants (Irradiation swelling, Reactor component materials, Reactor fuel, Application of non-destructive testing methods; Nuclear radiation effects, Fundamental



radiation damage), Propellants: Explosives & Solid rocket fuels, Catalytic materials.

MATERIALS ENGINEERING

EN562 Fuel and Clean Technology (3-0-3): Fossil fuel processing towards green technologies, CO₂ sequestration, Pollution monitoring, BIOMASS (Biomass resources & potential contribution, Biomass and waste technologies, Biomass heat digestion, Gasification, Anaerobic digestion, Biofuel technologies, Bio harvesting, Environmental issues, Economics & costs), Wind energy, Solar & Tidal Energy, Geothermal energy, Hydroelectric Power plants, Clean technology applications & materials fabrication for Clean tech. (aerogels & sol gels etc.)

EN572 Thermal and Nuclear Power Plants (3-0-3): 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 energy history and importance, Fission, Fusion & 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.

EN573 Hydrogen Storage Materials (3-0-3): Materials and alloys for Hydrogen storage, New developments and materials CNTs, oxyfuel cells, Hydrogen reforming, production and economy, compressed & liquid hydrogen (low temperature & vacuum technology) storage, hydrogen storage by hydrocarbons, carbohydrate fuels, metal hydrides, complex hydrides, Advanced technologies for hydrogen storage, light metal alloys, Nanotech Materials for hydrogen storage, adsorption & absorption in metal-organic frameworks & thin film technology.

EN574 Nanotechnology in Energy (3-0-3): High diversity and high performance materials and nanodevices, Fabrication technique, New generation of nanostructural materials for low energy devices sensors and equipments, Fabrication techniques, Deposition



techniques, photolithography, electroless and electrochemical deposition, etching, and through mask plating.

EN581 Solar and Fuel Cells technology (3-0-3):

Electrochemistry & electrochemical power sources, Batteries, Capacitors, Fuel cell introduction (Fuel supply), Gas solid and liquid solid reaction, Heterogeneous catalysis, Fuel cell types, operation & material fabrication, Mass & Energy transfer related issues, Fuel cell application, Fuel cell limitation (response to impurities, environmental hazards etc.), Principles of photovoltaics and photothermals, Other techniques for capturing solar energy.

Electrical and Electronic Engineering

EN511 Transmission and Distribution of Electric Energy (3-0-3):

Factors which are important 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, field effects, and heat transfer.

EN515 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.

EN516 Photovoltaic Energy and Its Applications (3-0-3): Applications of Solar Energy, Solar Radiation, Solar Cells: Technology and Properties, Photovoltaic Engineering, Photovoltaic Energy Applications, Environmental Impacts 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.

EN517 Electronics for Energy Control (3-0-3): Single and three phase converter, HVDC, FACTS, UPS, Wind Turbines, Fuel Cells, Electric Vehicles, variable speed drives, semiconductor devices used in power electronic



systems, static converters for single and three phase rectification and inversion design, standby and portable ac supplies, and AC transmission networks, dynamic voltage restorer applications, DC/DC converters for Fuel Cell and Electric Vehicle applications.

EN643 Advanced Process Control (3-0-3): Introduction to automatic control theory and structures, process systems and process models, process control of the common unit processes, process control in large industrial complexes, robust processes control.

MECHANICAL ENGINEERING

EN531 Thermodynamics and Heat Transfer (3-0-3): Formulation of steady and unsteady, multidimensional conduction in different geometries. Methods of solution including separation of variables, and numerical methods. The concept of boundary layer. Continuity, momentum and energy equations. Internal and external flow. Electromagnetic background and definitions. Black body radiation. Radiation from real surfaces. Radiative energy transfer between surfaces and enclosures. Laws of thermodynamics, entropy, exergy and applications of thermodynamics.

EN535 Air Conditioning and Refrigeration (3-0-3): Summer and winter air conditioning load calculations, air conveying and distribution, fans, duct design, and diffusion apparatus for producing comfort in summer. All year air conditioning methods and equipment, automatic control for air conditioning systems. Refrigerants. Types of refrigeration systems.

EN536 Internal Combustion Engines (3-0-3): Properties of working fluid. Scavenging in two-stroke cycle engines, supercharging. Modeling real engine flow and combustion processes. Engine operating characteristics.

EN594 Renewable energy (3-0-3): Hydro, Tidal, Wave,

Bio-energy, Wind, Solar, Geothermal, Solids Resource Management, Water and Wastewater Treatment Processes, Hydrogen and other storage mechanisms.

EN595 Solar Energy Utilization (3-0-3): Advanced topics including passive, active and hybrid heating techniques, thermal storage and solar ponds, equipment in solar systems, solar distillation and evaporation, solar cooling and refrigeration, solar pumping and irrigation, high temperature applications, photovoltaic, utilization of other renewable energy resources, biomass, wind energy etc.

GENERAL AND MANAGEMENT ELECTIVES

EN521 Industrial Safety (3-0-3): Accidental prevention, Ergonomics and protective equipment, Fire

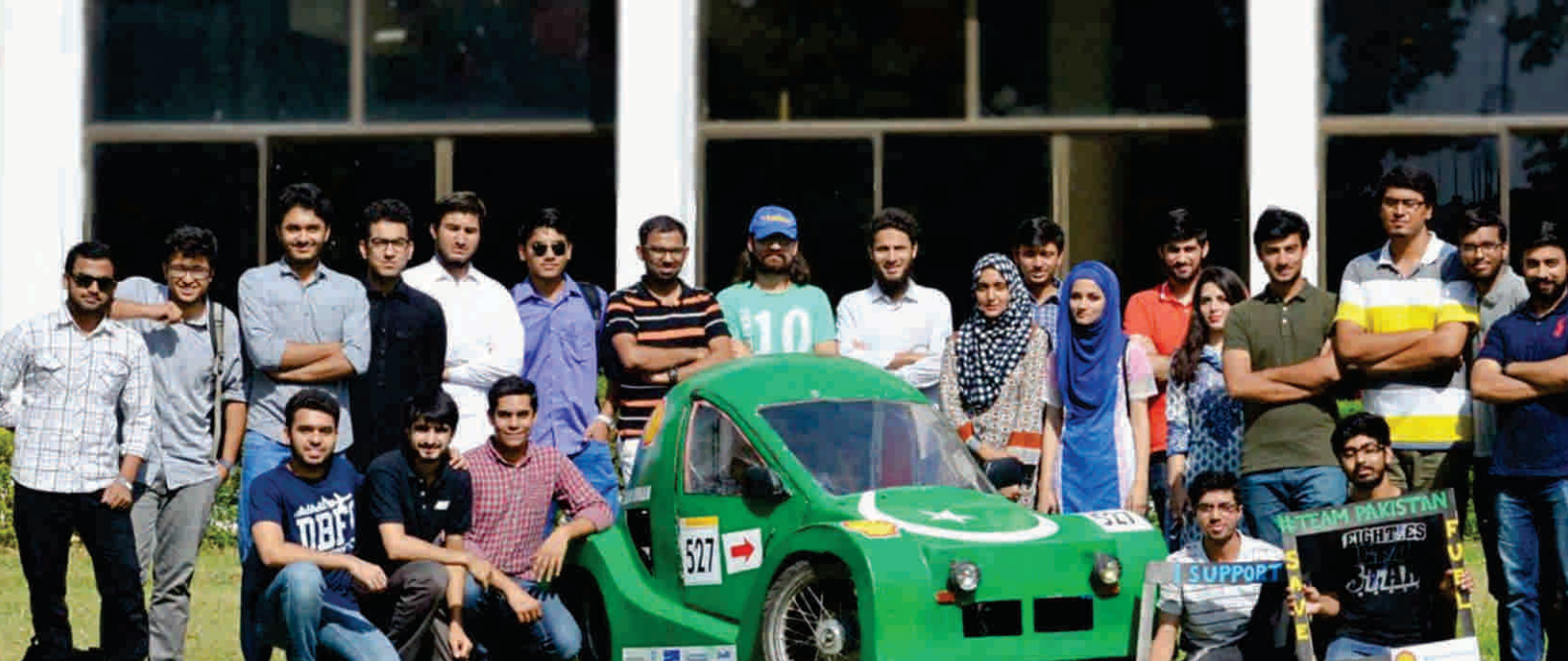
prevention and control, Concept of total loss control.

EN551 Sustainable Development (3-0-3): 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 crisis, health, ethics, management for development.

EN552 Energy Economics (3-0-3): Energy and Economics, Trends in Energy Production and Consumption, Economic efficiency, Growth, and Modeling, The Primary (Extractive) Energy Industries, Coal, Oil Natural Gas, Electric Utilities and Regulation, Nuclear Power, Social welfare



LAB FACILITIES AND RESEARCH GROUPS



Faculty of Computer Sciences and Engineering

FCSE has a number of laboratories equipped with the state of the art computer systems running a wide range of applications and specialized software supporting the courses and research projects.

PC Lab

Personal Computing Laboratory is the central lab of the Institute that provides general purpose computing facilities to all students across campus. The lab is also used for email and Internet access and is open seven days a week from early morning till late night. This lab houses over 100 core i-7/i-5 machines networked on Windows 7. The lab also provides a printing facility to all GIK Institute students. Student workshops and software competitions are held in this Lab. Introduction to Computing and Programming and Intensive Programming modules are also conducted in this lab. Faculty of Mechanical Engineering uses this lab in the second semester for Engineering Drawing lab. DSL and WiFi facilities are also available.

Software Engineering Lab

This Lab is used for multiple courses. It has 50-networked Core i-7 computers connected to database server as well as other servers of the Institute. This lab contains software like Eclipse, various compiler tools, Oracle, Rational Rose, Prolog, IT Guru and Packet Tracer as well which are used for various courses like Software Engineering I and II, Language and Compilation Techniques, Computer Communication and Networking, Artificial Intelligence and Databases. This lab remains open from 8:00am to 5:00pm throughout the week. It also provide printing facility to all the Computer Science and Engineering Students as well as to the Graduate Students. Moreover, student workshops and software competitions are held in this Lab.

PSD LAB

The Software Development Laboratory is equipped with 50 core i-5 machines; which are networked by Gigabits switches. The Lab caters for the needs of Data Structure & Algorithm, Compiler Construction, Programming Techniques and Digital Image Processing courses. The lab hosts a wide variety of specialized software such as MATLAB, SQL/ Developer, Dev C++, Code Block, Rational Rose and the Microsoft .NET Framework.

Operating System Lab

The Operating System Lab houses 100 DELL core i-7/i-3/Core 2Duo machines networked on Windows 7 and Windows 10. The lab is also used for email and Internet access and is open from early morning till 5pm. The lab accommodates the requirements of Digital Image Processing, Operating Systems, and Systems Programming courses. Student workshops and software competitions are held in this Lab.

Graduate Lab

The Graduate Laboratory, recently established for the graduate students, is the central venue for ongoing research as part of the graduate program. Equipped with Core i7 workstations, the laboratory provides each graduate student with a dedicated machine connected to the Internet.

CPU Room

The FCSE administers a Central Processing Unit Room that is the backbone of all computing resources across campus and connectivity to the outside world. It has a number of high-speed server-class machines and equipment including 4 server of Dell Intel Xeon power edge R420 Dell Dual Core Intel Xeon Server (Power Edge 2900 System), two servers of HP ProLiant PL 380 G7 and two Intel Xeon Nehlim Servers router(s) (Cisco and Huawei) and Layer-3 switches. All these servers are running 24/7 and are two backed up with un-interrupted power supplies 20kva and 10 kava; the UPS is enable to

support 3-5 hours of operation after power failure. Two Generator 45 KVA auto Generator and Manual Generator 100KVA. All faculties and labs are connected to the CPU room for email/Internet access and other computing and resource sharing.

High Performance Computing Facility

An AMD Opteron based computing cluster was installed in the FCSE faculty in 2006. Currently graduate and undergraduate students and faculty use it to study various problems in the scientific and engineering domains. This facility is also intended as a hub and a model for scientific technical/industrial and business/commercial organizations of Pakistan to support their high-end computing needs. Recently, this facility has been upgraded through a grant (Dr. Masroor Hussain, PI) using Rs. 10 million funds from Directorate of Science and Technology, Government of Khyber Pakhtunkhwa. The facility consists of 160 CPU cores, 1024 GPU core, 640 GB main memory and 10GB Ethernet switch interconnection. The High Performance Computing facility is aimed at serving highly compute intensive research projects for the higher education sector of the entire country over Pakistan Education and Research Network. The facility is accessible remotely and is located at the CPU Room of the Faculty of Computer Science and Engineering.

The faculty is currently operates a set of cluster labs managed by various senior faculty members. A few of the established lab are described below.

The Telecommunications and Networking (TeleCoN): The Telecommunications and Networking (TeleCoN) is an inter-faculty Research Centre jointly established by the Faculty of Computer Sciences & Engineering and the Faculty of Electrical Engineering. The TeleCoN Lab fosters 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 group promotes pure and applied research employing cutting-edge network, communication and signal processing techniques and technologies. General areas of interest include resource allocation, traffic/tele-traffic management and engineering, security, energy efficiency, communications and quality of service in Internet, wireless sensor networks, mobile ad hoc and vehicular and cognitive radio networks, multi-user relay networks and 5G heterogeneous cellular networks. Other activities of the Centre include the organization of seminars, workshops, lectures, trainings and invited talks to promote the objectives of the group.

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 Institute. The group provides a platform for bringing together faculty members and students interested in conducting cutting edge research in the following areas: Data Science, Machine Learning, Computational Intelligence, Data Mining & Knowledge Discovery, Multi-Agent Systems, IoT, Affective Computing, and Intelligent Transportation Systems. The group has successfully produced many Ph.D. and MS scholars. Most are working in various national and international organizations. MInG provides a platform where scholars get the opportunity to learn and groom under the supervision of experienced computer scientists.

Machine Vision and Perception Group (MVPG): Machine Vision and Perception Group (MVPG) has been involved in quality research in medical analysis and diagnostics using medical imaging for the last seven years. In 2011 the lab won a grant of PKR480,000 from DoST, KPK for a project on automatic classification of prostate cancer tissues using wavelet packet transformation on histological images. Another project was on automatic

segmentation of subcortical regions using nonlinear warping techniques on brain MRIs which were published in FIT conference in 2010. Recently, the lab has also received a HEC grant of PKR452,300 for a project on brain image analysis. The lab has been involved in offering various digital image processing related final year projects.

The Machine Learning and Data Science Lab (MDS): The Machine Learning and Data Science Lab is the premier interest group of the Faculty of Computer Science and Engineering focusing on the development and application of machine learning algorithms in data science. The Lab is managed by a dedicated team of faculty and students working on all aspects of machine learning and inference of large statistical models. Major interests span theoretical foundations, inter-disciplinary research and novel applications of cutting-edge machine learning techniques including NLP, bioinformatics, social network analysis. The MDS lab regularly holds group meetings and seminars to share experience and discuss solutions to complex problems.

The Monotonic Adaptive Kernel Lab (MAK): The Monotonic Adaptive Kernel Lab is a unique group of the Faculty of Computer Science and Engineering focuses on Operating Systems, Embedded Systems and Computational Sciences including video encoding and cyber and IoT security. The research includes tasks assignment, parallel and distributed processing, modelling and simulation and engineering optimization. The lab has produced many BS, MS and PhD graduates. Currently, this group is working with IBM, Western Michigan State University and other reputed international organizations. This lab houses the state-of-the-art machines like Macintosh, Dell and other high-end servers.

Faculty of Electrical Engineering

Keeping in mind present and future needs, 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. These facilities provide them with the opportunity to learn and understand the concepts of electronic and power engineering and constructively transform them to practical use. Major laboratory facilities are summarized below:

Wave Propagation and Antennas Lab

This lab houses 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 for practical experiments pertaining 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. Here Students learn practically the synchronization of two electricity networks and the power flow between them as well.

Digital Logic Design Lab

This lab is meant for the understanding of fundamental digital logic related concepts and houses 30 sets of oscilloscopes, digital trainers, Digital Multi-Meters (DMMs), function generators and support accessories. Starting with simple universal NAND/NOR gates,

students learn to design and implement different combinatorial as well as sequential circuits taught in the allied theory class.

Analog Electronics Labs

There are two analog electronics laboratories in the faculty, equipped with over 60 sets of oscilloscopes, trainers, power supplies and functional generators. The labs are used for courses on Electronics Devices and Circuits, Electronic Circuit Design and Linear Circuit Analysis. The labs augment the theoretical knowledge, which the students acquire in theory classes. On the basis of experiments in these labs, the students not only verify their theoretical analysis but also learn 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 students' knowledge 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 a 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-controllers and computers. Telephone switching module and optical fiber transmitter and receiver trainers are also available.

Telecommunications and Networking Lab

The Telecommunications and Networking (TeleCoN) Research Lab provides facilities 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 Lab promotes fundamental and applied research employing cutting-edge networking, communication and signal processing techniques and technologies. General areas of interest of the Group include resource allocation, teletraffic engineering, security, energy efficiency, policy-based management, admission control and quality of service in wired and wireless networks, and cooperative communications and multi-user relay networks in wireless and mobile ad hoc networks. The Lab contains dedicated computers with necessary software such as Matlab, NS, Latex, and Acrobat.

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 analysing electric and electronic circuits is used in the labs of Linear Circuit Analysis and 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 and Automation 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 pertaining 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 Analog Computers.

Microprocessor Lab

The intent of this laboratory is to provide an insight to a typical microprocessor and microprocessor-based systems. Used in Microprocessor Systems 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 modularised 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 (EOA) 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 a number of Xilinx/Altera FPGA development boards.

Electrical Measurement and Instrumentation Lab

This Lab covers investigation of instruments, error types and characteristics of instruments, determination of dynamic behaviour 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 i5 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 analysing electric and electronic circuits is used in the labs of Linear Circuit Analysis and Electrical Network Analysis, and Electronics Devices and Circuits. Power World Simulator is used for solving problems involving power flows. Calculux 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 state of art power distribution and utilization approaches and equipment. To strengthen the newly-launched specialization of 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
- High Voltage Engineering Lab

Research Group

I. Microwave and Photonics Research Group

Microwave and Photonics Research Group (MPRG) conducts research across a broad range of topics, both fundamental and applied. Applied research includes the design of selective structures, Tunable Metamaterials, Metasurfaces, and planar circuits for mm-wave microwave, optical range of frequencies. The Optical devices involve the for sensing and communication technologies. The methods for analysis include novel discretization techniques, fast methods in the frequency and time domains, and multi-scale analysis. Also the group has main focus on the simulations in advance software packages such as ADS, CST, HFSS, FDTD Lumerical, and COMSOL Multi-Physics and for analytical solution analysis the MATLAB, MATHCAD, and MATHEMATICA software tools are used.

Researchers

Dr. Adnan Noor (adnannoor@giki.edu.pk)
 Dr. Husnul Maab (maab@giki.edu.pk)
 Dr. Arbab Abdul Rahim (abbab@giki.edu.pk)
 Dr. Muhammad Mahmood Ali (m.ali@giki.edu.pk)

II. Organic Semiconductors Devices Research Group

The research group is investigating the electro physical Properties of Organic Semiconductors, Conductors and Superconductors Solar Cells and Sensors on the Base of Organic Semiconductors and Nano-composites. Also material processing at high gravity conditions utilization of renewable energy resources (Solar Energy, Hydropower, Production of Biogas, Wind power) is also included.

Researchers

KhasanKarimov (khasan@giki.edu.pk)
 Hadeed Ahmed Sher (hadeed@giki.edu.pk)
 Muhammad Muqeet Rehman (muqeet@giki.edu.pk)

III. Signal Processing and Communication Research Group

Information and communication technology, energy efficiency in hybrid mobile and wireless communication networks, digital signal processing, 4G and beyond mobile systems, mesh and adhoc networks, cooperative communications, cognitive radio networks, green networks, sensor networks, application of stochastic geometry in heterogeneous networks.

Researchers

Dr. Zia ul Haq Abbas (ziaul.h.abbas@giki.edu.pk)
 Ahmad Kamal Hassan (akhassan@giki.edu.pk)

IV. Power and Control System Research Groups

The main areas of research include the dielectrics, AC/DC transmission, modern electrical insulation, FACTS devices, and smart grid. Also it includes model order reduction of large-scale systems, robust control system design for multivariable systems, and Fractional control system.

Researchers

Prof. Dr. Nisar Ahmed (nisarahmed@giki.edu.pk)
 Prof. Dr. Muhammad Akbar (akbar@giki.edu.pk)
 Prof. Dr. Muhammad Amin (mamin@giki.edu.pk)
 Dr. Shahid Alam (s.alam@giki.edu.pk)



Faculty of Engineering Sciences

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
- Computer Architecture Laboratory
- Microprocessor/Microcontroller Interfacing Laboratory
- Engineering Instrumentation Laboratory
- Modern Physics Laboratory
- Simulation Laboratory
- Semiconductor Laboratory
- Lasers and Optics Laboratory.

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

Thermal Analysis Laboratory

Has state-of-the-art equipment purchased from PerkinElemer such as differential scanning calorimeter (PerkinElemer DSC-7), differential thermal analyser (DTA-7), thermal gravimetric analyser (TGA-7) and dynamic mechanical analyser (DMA-7). The equipment can be used to investigate the kinetic parameters, and change of mass and mechanical properties of various materials with temperature. Moreover, the equipment has direct application for the product development in the paper, ceramic, polymer, rubber, glass and paint industries.

Spectroscopy Laboratory

Contains PerkinElemer, Fourier transform infrared

spectrometer (FTIR System 2000) and UV/VIS/NIR (Spectrometer Lambda-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

nanomagnetism instruments, UK. At present lab contains nanomagnetism 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.

Research Groups

I. Organic Photonics and Electronics (OPE) Research Group

The group has produced the largest number of PhD students in numerous multi-disciplinary areas in the history of the GIK Institute. The Organic Electronics and Advanced Photovoltaic Research Labs established by the group are providing training to nationwide training to academia and industry in advance organic electronic and photonic technologies. The group of "Organic Electronics and Photonics" performs research in (i) Green Photonics, Printed Photonics, (ii) the computational

design and synthesis of organic semiconductors, quantum dots, nanoparticles, and nanocomposites, (iii) characterization of various types of optical and electronic properties, (iv) the design and fabrication of organic electronic and photonic devices, such as, junction diodes, transistors, memories, sensors, next-generation solar cells, (v) design and development of next-generation solar cell technology based solar panels, etc. The group is composed of a strong team of researchers from fields of electronic engineering, materials engineering, physics and chemistry. The Organic Electronics and Photonics Research Group (i) is equipped with state-of-the-art research facilities for the fabrication and characterization of organic electronic and photonic devices, (ii) possesses licensed Gaussian and ADF Codes for performing TDDFT calculations.

Group Leader: Prof. Dr. Muhammad Hassan Sayyad (sayyad@giki.edu.pk)

II. Computational Physics Modeling & Simulation (CPMS) Research Group

Computational Physics Modeling & Simulation (CPMS) group is part of a world-wide effort to microscopically calculate the input parameters for simulation and modeling of various (astro) physical events. The CPMS group is mainly concerned with the calculation of nuclear input parameters. The results are then forwarded to collaborators running simulation codes on super computers. Various nuclear models (e.g. QRPA and shell model) are employed to calculate the input parameters in a microscopic fashion. Numerical techniques, computer programming and understanding of the physical phenomena are the basic requirements. The CPMS group deals with research areas including but not limited to (i) r-, s-, p- and rp-process calculations. (ii) Double beta decay calculations (two-neutrino and neutrinoless modes. (iii) Calculation of nuclear partition

functions, nuclear level densities and nuclear abundances. (iv) Calculation of β -decay half-lives for exotic nuclei. (v) Calculation of allowed Gamow-Teller, Fermi and forbidden charge-changing transitions. (vi) Calculation of weak-interaction mediated rates in stellar conditions. (vii) Use of pn-QRPA, Shell model, Pyatov method, Schematic Model and other nuclear models to microscopically calculate the nuclear data. (viii) Renewable energy technologies. (ix) Whirlpool turbine technologies. 08 PhD and 21 MS students have so far conducted their research work in CPMS Group. This also includes the first ever foreign PhD student who conducted her research work in CPMS Group. Not only pure theoretical, but also experimental and computational work is carried in the CPMS Group.

Group Leader: Prof. Dr. Jameel-Un Nabi, FInstP (jameel@giki.edu.pk)

III. Digital Systems Engineering Research Group

The group is established because Digital Systems are everywhere; in Toys, Tablets, Laptops, Desktop Computers, Mobiles, Home Appliances, Office Machinery, Medical Equipment, Entertainment Devices, Speech synthesis, Signal Processing, Multimedia, Digital communication, computer networks, Data Security etc. and their applications are ever increasing. Internet of Things (IoT), an emerging trend in cyber technology has already wirelessly connected and integrated Billions of things via the Internet. It is expected that everything on the globe shall similarly be interconnected. Job opportunities of expert in this area are very high. Similarly there are challenges as the technology advances. The focus of this group is to teach the fundamentals of Computer Engineering, Digital Control Systems and Digital Communications; and to do research to explore new avenues and solve the problem arising in deployment of new technologies.

Group Leader: Prof. Dr. Habibullah Jamal (habibullah@giki.edu.pk)

IV. Symmetries and conservation laws in some well-known space time

Recently we are working on find the symmetries like Killing, homothetic and conformal vector fields in general relativity and teleparallel theories gravity. The aim of this group to extend this study to Noether's Symmetries and find its Conservation Laws. We hope we will be able to find some relation between Noether's affine Symmetries.

Group Leader: Prof. Dr. Ghulam Shabbir (shabbir@giki.edu.pk)

V. Numerical Analysis Group

Numerical Analysis deals with the development of robust and efficient algorithms for problems arising in various areas of engineering, science and finance. These problems are modeled via ordinary and partial differential equations having derivatives of integer and fractional order. The main thrust areas are combination of finite differences with RBFs and Haar wavelets, optimal homotopy asymptotic method (OHAM), differential transform method (DTM), Legendre wavelet collocation method (LWCM) and Spline based techniques.

Group Leader: Prof. Dr. Sirajul Haq (siraj@giki.edu.pk)

VI. Nanotechnology (NanoTech.) Research Group

Nanotechnology Research Laboratory (NanoTech. Lab) aims to fabricate innovative electronic, optoelectronic and fuel cell devices that exhibits novel properties and functions. Main focus of Nano Tech. Lab is the fabrication and characterization of two-dimensional (2D) materials and their heterostructures. Owing to their intriguing material properties, 2D materials (graphene,

hBN and TMDCs) have attracted extensive attention in recent years. The Nano Tech. Lab envisioned to use these 2D materials in photonics, optoelectronics, spintronics, electronics and biosensing devices. Furthermore, the group deals with the following areas of research and characterization: (i) Optoelectronic devices, (ii) Fuel cells. (iii) Chemical/Biosensors (iv) Electrical Impedance Spectroscopy (EIS) (v) Cyclic Voltammetry (CV) and, (vi) Gate dependent electrical transport measurements.

Group Leader: Dr-Dr. Muhammad Zahir Iqbal (zahir@giki.edu.pk)

VII. Semiconductor Research Group

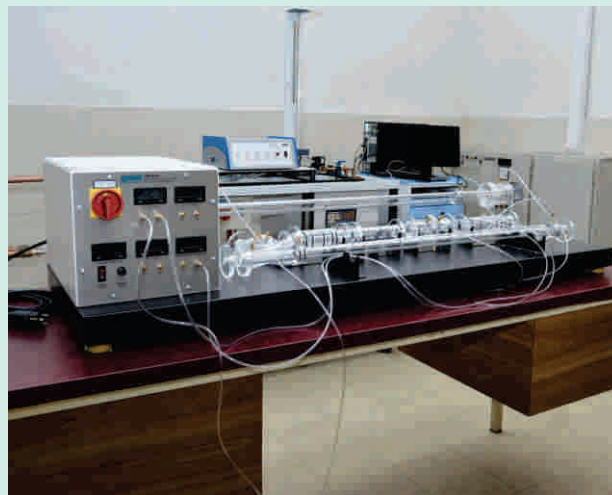
Semiconductor Technology is the mother of all the technical advancement happening now a day. Therefore, to meet the future trends of technology the Semiconductor research group has been established at GIK Institute. The purpose of this group is to provide the state of the art solution to the industry and the academia. It provides the very strong footing for the development of the electronics industry in the area of organic/inorganic electronics, photonics, nanotechnology and renewable energy technologies. Research areas targeted by the semiconductor research group are the organic/inorganic semiconductors, sensors, lithographic processes, basic electronic component fabrication like diodes, transistors, capacitors, resistors and FETs. The semiconductor research group is also working on the Telemetry systems and digital systems to improve the performance of the products. The semiconductor research group has also proposed the very new innovative ideas in the field of renewable energy technologies on the basis of organic/inorganic materials by taking advantage of the nanotechnology.

Group Leader: Dr. Tahseen Amin Khan Qasuria (qasuria@giki.edu.pk)

VIII. System, Control and Applied Analysis (SCAA) Research Group

The research program Systems, Control and Applied Analysis (SCAA) is devoted to the analysis, control and optimization of complex dynamical systems. The focus is on fundamental mathematical research, stimulated by collaborations with colleagues from the engineering and natural sciences. Mathematical systems and control theory deals with the modeling and control of open and interconnected systems evolving in time. The dynamical behavior is not only sought to be analyzed, but to be influenced (controlled) and optimized as well; by the addition of feedback loops, and by the interconnection to other dynamical systems (controller design), or the optimal selection of parameters. Furthermore, the systems point of view is emphasized, by viewing complex systems as networks of simpler components.

Group Leader: Dr. Dur-e-Zehra Baig (zehra@giki.edu.pk)



Department of Materials Science and Engineering

Lab Facilities:

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

Scanning Electron Microscopy laboratory (SEM Lab)

SEM or the scanning electron microscopy laboratory provides the high tech materials characterization. The lab is mainly used for surface characterization of almost all kinds of engineering materials along with the facility of composition analysis of alloys. For the study of surfaces at high magnifications (up to 400,000x). Surface morphology for fracture analysis, coating defects, porosity, chemical analysis and micro-structural studies, Grain boundary and deformation texture analysis using EBSP channeling patterns. Associated sample preparation equipments – sputter coater and ion milling machine.

X-ray Diffraction Laboratory (XRD Lab)

XRD lab is extensively used by the students of FMCE as well as the students of other departments for their technical and research projects. This Lab is mainly used for identification of crystal structures and phases, texture analysis for preferred orientation developed in plastic deformation and annealing, residual stress analysis and an in-situ study of phase transition in materials.

Nano- and Biomaterials Laboratory

Research facilities for sol-gel synthesis, hydrothermal synthesis of nanomaterials, thin films development by spin-coating, calcination and thermal processing, biomaterials and composites development and in-vitro studies.

Metallography Laboratory

Optical Microscopy Laboratory lab contains the sample preparation facilities i.e. cutting, grinding, polishing, chemical and electrochemical etching. The lab is also equipped with optical microscopes for micro-structural examination of metals, alloys, ceramic, polymer and composite materials; Nomarski interference contrast; photomicrographic printing, video display of microstructures and micro-hardness 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 machine 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 Film laboratory

Thin Film laboratory has the facility of thermal evaporator to deposit the this films of metals and alloys.

Arc Melting Furnace Laboratory

Arc melting laboratory has got the facility of ARC melting furnace which is primarily used to develop metallic alloys and bulk metallic glasses at lab scale 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 got the facilities to heat treat metals and alloys. the main equipment include Box and tube type electrical furnaces (up to 1600 ° C for phase transformation and recrystallization studies) Vacuum and temperature controlled furnaces, Jominy end quench test apparatus (for hardenability experiments) Quenching and stress relieving facilities.

Materials Processing laboratory

The materials processing laboratory mainly contain the facilities to process the metallic and powdered materials i.e. Rolling Mill (lab. scale) Hydraulic press and compaction dies.

Melting and Casting Laboratory

Melting & Casting Laboratory contains almost all the facilities of conventional metal casting i.e. Induction heating furnaces (melting and casting of ingots in air or under vacuum) Sand testing equipment (tensile, compression, shear, permeability standard/non standard) Sieve analysis (determination of sand particle size distribution) Mould preparation; Mueller sand preparation facility. Casting (sand casting, shell casting, full mould casting, investment casting, sodium silicate/CO₂ process casting, centrifugal casting. Facilities for squeeze casting and spin casting have been also been developed.

Workshop

In FMCE the workshop facilities are also available which are mainly used for sample preparation for mechanical testing laboratory, Cutting, shaping, milling and drilling of samples, and general maintenance. Workshop has also got the facilities of lathe machining, electric arc and gas welding , brazing, soldering and other joining facilities.

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) have been acquired to study and correlate the composition and process parameters with the mechanical properties of polymers and particulate composites.

Atomic Force Microscopy (AFM) Laboratory

FMCE has recently established an Atomic Force Microscopy (AFM) laboratory for materials characterization especially at nano scale level. AFM is an advance characterization technique capable of performing many kinds of materials analysis i.e. high resolution imaging, magnetic characterization, nano lithography, nano indentation etc. The AFM lab is useful both for the teaching and research work.

Research Groups

The Department of Materials Science and Engineering is one of the leading research-intensive departments in Pakistan. It houses a wide range of laboratories and modern testing facilities to cater for research and investigation on diverse range of applied engineering materials. These laboratories provide support for research and development to our graduate students and faculty in a variety of research areas. The faculty interacts through various interdisciplinary research groups to sustain research productivity, facilitate students and researchers, develop industrial linkages and promote socio-economic national development.

Corrosion Engineering Research Group

The objective of this research group is to evaluate and simulate the corrosion and oxidation behaviour of high performance materials by using the laws of thermodynamics and kinetics of corrosion. Further

analysis is performed by using modern corrosion analysis tools and techniques to finally develop the ways to control corrosion and degradation of materials.

Principle Investigator:

Dr. Fahd Nawaz Khan (fahd@giki.edu.pk)

Smart and Nanostructure Materials Research Group

The smart and Nanostructure Materials Research Group works in the area of metallic and non-metallic smart materials and explores their potential applications especially in the fields of energy, advanced engineering components and biomedical implants. While working both at micro and nano scales, the research efforts of the group continue to develop an in-depth understanding of the fundamental characteristics, design, synthesis and fabrication of novel smart materials.

Principle Investigator:

Dr. M. Imran Khan (imrankhan@giki.edu.pk)

Biomechanics Research Group

The Biomechanics research will focus on understanding the structure, property and performance relationship between 1st, 2nd generation biomedical alloys and coatings. The specialty of this work is use of a state of the art nano-indentation technique that will be used for the first time on these materials to understand their biomechanical attributes at high spatial resolution. This will enable us to develop ongoing collaboration with the biomedical industry and commercializing innovative solutions through expertise of highly qualified faculty. The group will also contribute in producing and training of new researchers; conducting short courses and workshops, and publishing research in high quality journals and conferences.

Principle Investigator:

Dr. Yasir F. Joya (yasir.joya@giki.edu.pk)

Materials for Energy and Environment Research Group

The materials for energy and environment group will focus on the research theme of advanced nanomaterials for energy production, storage and applications. The objective of the group is to advance technical excellence through collaborative, innovative research in science and engineering. The group will continue to develop and train highly qualified researchers; conduct internationally leading research in materials science and engineering and interact with stakeholders to achieve knowledge transfer.

Principle Investigator:

Dr. Yasir F. Joya (yasir.joya@giki.edu.pk)

Ceramics and Composites Research Group

Composites are an ever emerging class of materials that are widely being used in various applications due to the possibility of tailoring their properties as per requirements. They are classified in three broad categories; Ceramic Matrix Composites (CMCs), Metal Matrix Composites (MMCs) and Polymer Matrix Composites (PMCs). Most of the CMCs and MMCs are being used in high-tech applications including aerospace applications requiring high working temperatures. Whereas the uses of PMCs range from various domestic applications to the high tech applications like making of airplane fuselage. With the evolution of nanotechnology, the production and use of nano-composites have also got attention of the researchers and the end users. The Ceramics and Composites Research Group is keen to develop and explore the advanced composites and ceramics for their potential applications in aerospace, biomedical implants, energy storage devices (rechargeable batteries, capacitors) and automobile sector.

Principle Investigator:

Dr. Ramzan Abdul Karim (ramzan.karim@giki.edu.pk)

Nano- and Biomaterials Research Group

The Nano and Biomaterials group's work centres on the research theme of bioactive and biodegradable alloys, nanoceramics, polymers and nanocomposites for healthcare applications. These materials are capable to act as bone scaffold for hard tissue repair, being absorbed by the body at the same rate as bone cells are replaced. The group is devoted to advance technical excellence through collaborative, innovative research in Nanotechnology discipline.

Principle Investigator:

Prof. Dr. Ashraf Ali (drashraf@giki.edu.pk)

Materials Failure Analysis Research Group

This research group will focus on failure due to overloading of material beyond its failure strength, improper materials processing, improper component design and major failure mechanisms such as fatigue, residual stresses and creep. Research activities include mechanical testing, characterization and simulation activities for the prediction and finite element description of different failure modes in engineering materials and for suggestions of failure counter-measures.

Principle Investigator:

Dr. Rashid Ali (rashidali@giki.edu.pk)

Advanced Materials Research Group

This research group investigates the fabrication and characterization of advanced materials like Amorphous Materials, Bulk Metallic Glasses (BMGs), Ferromagnetic Shape Memory Materials (FMSM) and High Entropy Alloys, etc.

Principle Investigator:

Dr. Syed Zameer Abbas (zameer@giki.edu.pk)

DEPARTMENT OF CHEMICAL ENGINEERING

Lab Facilities

The laboratories for chemical engineering program at the Faculty of Materials & Chemical Engineering provide the needs of undergraduate & graduate education research, development and outside consulting. A brief description of lab facilities appears below:

Industrial Processes

- Water analysis, milk analysis, soap analysis, urea analysis, cement analysis and leather analysis.
- One can evaluate the quality of the raw materials and product of different industrial products. The facility is equipped with Gabber machine, microwave oven, ovens, furnaces, water bath, safety personal protective equipment (PPEs), fume hood along with inventory of necessary chemicals and glass wears.

Energy Engineering

- Automatic Aniline Point Apparatus
- Cleveland Flash and Fire Point Tester
- Conradson Carbon Residue Apparatus
- Softening Point Apparatus
- Cloud and Pour Point Unit
- Penetrometer

Particle Technology

- Solids Handling Unit
- Fixed and Fluidized Bed Unit
- Plate and Frame Filter Press
- Sedimentation Study Unit
- Liquid Solid Study Unit

- Oil Extraction Screw Press

Fluid Flow

- Pipe Fitting Loss Demo Panel with data Acquisition System
- Plastic Tank with Submersible Pump
- Base Module for Experiments in fluid Mechanics
- Calibration of Pressure Gauges
- Plate Weirs
- Centrifugal Pump
- Hydrostatic Pressure in Liquids Apparatus
- Methods of flow Measurement
- Water Hammers and Surge Chamber
- Series and Parallel Connected pumps
- Characteristics of nozzle unit
- Compressible flow unit

Environmental Engineering

- Ion Exchange
- Reverse Osmosis
- Depth Filtration
- Aerobic Digester Unit
- Anaerobic Digester Unit
- Aeration Unit



Heat Transfer

- Tubular heat exchanger
- Plate heat exchanger
- Shell and tube heat exchanger
- Jacket vessel heat exchanger
- Film and drop-wise condensation
- Free and forced convection
- Evaporation process unit
- Conduction unit
- Radiation unit

Chemical Reaction Engineering

- Supply unit for chemical reactor
- Stirred tank reactor
- Tubular reactor
- Fixed bed catalytic reactor

Simultaneous Heat and Mass Transfer

- Diffusion in liquids and gases
- Distillation column
- Gas absorption
- Convective drying
- Cooling tower
- Steam generator



- Liquid-Liquid Extraction unit
- Adsorption unit
- Control of Water Quality unit
- Crystallization unit
- Absorption refrigeration unit

Instrumentation and Process Control

- Pressure control system
- Temperature control system
- Flow and level control system
- Pressure measurement unit
- Temperature measurement unit

Simulation and Modeling

- Software: AspenOne Suit

Research Groups**Energy Conversion and Recovery Technologies**

Designing and upgradation of present processes for efficient utilization of energy is basic requisite of process engineer. Therefore, this research group includes the study and research of technologies involving energy. The main areas of research of Energy Conversion and Recovery Technologies are Energy, Management, Auditing, and Control, Clean Fuel Technologies, Waste Heat Recovery and Waste Management.

Chemical Processes, Synthesis and Modelling

There is continuous requirement of chemicals and products for bulk use. Chemical engineers develop the process for the mass production. This group focused on chemical process development for production of chemicals, the process modelling and simulation. The areas of research mainly focused on, water treatment technologies, reaction engineering and process modelling and simulation.

Faculty of Mechanical Engineering

FME is equipped with following labs to aid its research groups:

1. Solid Mechanics Lab
2. Fluid Mechanics Lab
3. Heat Transfer Lab
4. Heat Engine Lab
5. Natural Fluids Refrigeration Center
6. Automobile Lab
7. Wind Tunnel Lab
8. Mechanical workshop
9. Vibration and Control Systems Lab
10. Instrumentation and measurement Lab
11. Manufacturing and Industrial Lab
12. Computational Lab

Research Groups

Design and Manufacturing

Main research areas in Design & Manufacturing include:

- Friction stir welding/processing
- Laser/Electron beam
- Sustainable manufacturing
- Additive manufacturing
- Composite manufacturing
- Incremental sheet forming
- High speed machining
- Deformation machining
- Manufacturing systems

The research in these 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). Several characterization apparatuses such as SEM, AFM, XRD, Tensile test machine are also available to

support the research. The group also has collaboration with industry to solve real-life problems and to use their facilities if necessary.

Researchers

Dr. Wasim Ahmad (wasim@giki.edu.pk)

Dr. Khalid Rehman (khalid.rehman@giki.edu.pk)

Dr. Ghulam Hussain (ghulam.hussain@giki.edu.pk)

ii. Thermo Fluids

Main research areas in the thermo-fluids group include:

- Design and Development of micro hydro turbines
- Solar thermal energy applications
- Performance analysis of Natural Fluids Refrigeration
- Analysis of performance and emission characteristics of internal combustion engines

The research in the aforementioned areas is being assisted by various facilities in the energy systems labs. It includes Natural Fluids Refrigeration Centre (NFRC), in which variety of condensation and evaporation heat transfer experiments can be conducted with minor changes in the setup, using natural refrigerants in different types of heat exchangers. Similarly, IC 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 bio-fuels. The heat transfer lab is also assisting in research topics like design and development of solar food dryers using phase change materials, micro channel heat sink design and vortex flow heat exchanger design. Micro-hydro turbines design and development is another key area of on-going research work at FME.

Researchers

Dr. Javed Ahmad Chattha (chattha@giki.edu.pk)
 Dr. Maher Ghazal (maher.ghazal@giki.edu.pk)
 Dr. Muhammad Asif (masif@giki.edu.pk)
 Dr. Mykola Bannikov (bannikov@giki.edu.pk)
 Dr. Taqi Ahmad Cheema (tacheema@giki.edu.pk)

iii. System Dynamics and Control Systems

The current research of the group is focussed on vibration analysis of high speed rotating shafts, finite element modelling of rotors i.e. rotor-dynamics as well as non-contact power transmission in rotating machines. Mathematical and experimental modelling of unmanned air and underwater vehicle is also being actively pursued. Real-time control of electro-mechanical systems such as Active Magnetic Bearings, Unmanned Air and Underwater Vehicles is also in-progress. The lab is well equipped with DAQ cards, oscilloscopes, power supplies, micro-controllers and variety of sensors.

Researchers

Dr. S. M. Ahmad (smahmad@giki.edu.pk)
 Dr. Sohail Malik (sohailmalik@giki.edu.pk)
 Dr. Adnan Hassan (adhassan@giki.edu.pk)

iv. Computational Mechanics:

The Computational Mechanics research group of FME deals with computational applied research related to various fields of mechanical engineering including

- Structural dynamics
- Multi-body dynamics,
- Material modelling
- Simulation of fluid dynamics, manufacturing processes and non-destructive testing (NDT).

The primary focus of the structural dynamics subgroup

is the computational analysis of structures under static, dynamic and environmental loading conditions. Material modelling of metallic and non-metallic materials such as fibre reinforced composites, polymers, laminates and rubber-like materials are subjects of research. The subgroup also addresses modelling of damage and fracture of metals, shear banding and necking in metals, polymers, delamination in composite materials and damaging processes in rubber-like materials.

Computational Fluid dynamics (CFD) subgroup is involved in fluid dynamics, fluid structure interaction (FSI) and thermal structure interaction (TSI). These Multiphysics approaches are being applied to micro hydro turbines, micro fluidics, bio-rheological applications, multiphase thermo-fluid flow, solar thermal energy and various aerodynamic applications. This group is also working in simulation of manufacturing processes like forming additive manufacturing, welding and simulation of multi-body dynamics like prosthetic limbs, robotic linkages etc. NDT group is working in the simulation of laser ultrasonics for crack detection in machine elements. The research group is also hosting postgraduate students working on research projects of industrial interests.

Researchers

Dr. Khalid Rahman (khalid.rahman@giki.edu.pk)
 Dr. Taqi Ahmad Cheema (tacheema@giki.edu.pk)
 Dr. Sohail Malik (sohailmalik@giki.edu.pk)
 Dr. Muhammad Ilyas (ilyas@giki.edu.pk)

FACULTY FOR GRADUATE PROGRAM

Faculty of Computer Science and Engineering

Dr. Khalid Siddiqui

Professor

PhD (Concordia University Montreal, Canada)

Specialization: Computer Science

Research Interests: Pattern Recognition, Non-destructive Testing

Dr. Zahid Halim

Associate Professor

PhD (University Name with Country): National University of Computer and Emerging Sciences, PK

Specialization: Computer Science-Computational Intelligence

Research Interests: Machine Learning and Data Mining [Probabilistic/Uncertain data mining, Graph mining], Intelligent Transportation Systems Computational Intelligence [Evolutionary Computation, Artificial Neural Networks]

Applications of Computational Intelligence in Games [Content generations, Enhancing user experience]

Dr. Syed Fawad Hussain

Associate Professor

PhD (University Name with Country): University of Grenoble, France

Specialization: Machine Learning, Data Science

Research Interests: algorithm development for machine learning, text mining, social network analysis, optimization problems, data science and big data, data clustering and analysis, feature selection, semantic learning, etc. with applications to real world problems.

Dr. Ghulam Abbas

Associate Professor

PhD (University of Liverpool, UK)

Specialization: Computer networks

Research Interests: Internet architecture, resource allocation, wireless communications and distributed systems

Dr. Masroor Hussain

Associate Professor

PhD (University Name with Country): GIKI, Pakistan

Specialization: High Performance Computing

Research Interests: Computational Science

Dr. Ahmar Rashid

Associate Professor

PhD (University Name with Country): Jeju National University, South Korea

Specialization: Electrical Impedance Tomography

Research Interests: Optimization Algorithms, Bioinformatics, Machine Learning and Computer Vision.

Dr. Rashid Jillani

Assistant Professor

PhD (University Name with Country): Florida Atlantic University, USA

Specialization: Digital Multimedia System,

Research Interests: Video Compression and Communication

Dr. Asif Khan

Assistant Professor

PhD (QMUL, UK and Klagenfurt University, Austria)

Specialization: Multi-robot Systems

Research Interests: Unmanned Aerial Vehicles (UAVs), Multi-UAV systems

Dr. Shahabuddin Ansari

Assistant Professor

PhD: Ghulam Ishaq Khan Institute, Pakistan

Specialization: Numerical Techniques

Research Interests: Computational Anatomy and Computer Vision

Dr. Sajid Anwar

Assistant Professor

PhD (Seoul National University, South Korea)

Specialization: Deep learning, GPGPU, Embedded Computing

Research Interests: Deep Learning Architectures and their Applications in Biomedical Engineering

Faculty of Electrical Engineering

Dr. Nisar Ahmed

Professor

Ph.D, University of London, Imperial College, London, UK

Specialization: Control Engineering

Research Interests: Krylov subspace methods for model reduction of large-scale systems, control and model reduction for linear parameter varying systems, and robust control system design for multivariable systems.

Dr. Khasan S. Karimov

Professor

Doctor of Physical Mathematical Sciences, Department of Heat Physics, Tashkent, Uzbekistan

Ph.D, Physical Technical Institute, S.-Peterburg, USSR, Russia

Specialization: Semiconductor Devices and Renewable Energy

Research Interests: Electrophysical properties of organic semiconductors, organic semiconductor devices (sensors, solar cells), materials processing at high gravity conditions (thin films), and utilization of renewable energy resources.

Dr. Muhammad Akbar

Professor

Ph.D, University of Tokyo, Japan

Specialization: Electrical Engineering

Research Interests: Dielectrics, AC/DC transmission

and equipment testing & quality assurance.

Dr. Muhammad Amin

Professor

Ph.D, UET Taxila, Pakistan

Specialization: Electrical Engineering

Research Interests: Electrical power engineering, modern electrical insulation, facts devices, and smart grid.

Dr. Zia-ul-Haq Abbas

Associate Professor

Ph.D, University of Agder, Norway

Specialization: Information and Communication Technology

Research Interests: Information and communication technology, energy efficiency in hybrid mobile and wireless communication networks, digital signal processing, 4G and beyond mobile systems, mesh and adhoc networks cooperative communications, cognitive radio networks, green networks, sensor networks, and application of stochastic geometry in heterogeneous networks.

Dr. Adnan Noor

Assistant Professor

Ph.D, University of Manchester, UK

Specialization: Electrical and Electronic Engineering

Research Interests: Metamaterials, plasmonics, and absorbers.

Dr. Husnul Maab

Assistant Professor

Ph.D, Quaid-i-Azam University, Islamabad , Pakistan

Specialization: Electronics

Research Interests: Surface electromagnetic waves (SPP, Tamm, Dyakonov-Tamm waves) in sculptured thin film, metamaterials, and wave propagation in complex medium.

Dr. Arbab Abdur Rahim

Assistant Professor

Ph.D, Politecnico di Torino, Italy

Specialization: Electrical Engineering

Research Interests: Magnetic materials, magnetic thin films, and spin wave in antidote arrays.

Dr. Shahid Alam

Assistant Professor

Ph.D: Chalmers University, Sweden

Specialization: Electrical Engineering

Research Interests: Electrical characterizations of insulation systems, and surface charge dynamics on polymeric materials for high voltage DC applications.

Dr. Muhammad Mahmood Ali

Assistant Professor

Ph.D, University of Malaya, Kuala Lumpur, Malaysia

Specialization: Electronic and Photonic Engineering

Research Interests: Fiber optics, optical fiber sensors fiber Bragg grating sensors and applications, modal characterization using phase plates and few-mode fibers, in-fiber mode converters for SDM technology, biomedical optics, superstructure fiber Bragg gratings and applications, UV excimer lasers for FBG writings

and CO2 laser for LPG writing, fiber lasers and nonlinear fiber optics, digital signal and image processing, electromagnetic field theory and microwave engineering, metamaterials and metasurfaces for microwave and optical applications.

Dr. Hadeed Ahmed Sher

Assistant Professor

Ph.D, King Saud University, Kingdom of Saudi Arabia

Specialization: Electrical Engineering

Research Interests: Photovoltaic applications, Power Electronics, Maximum Power Point Tracking, and Renewable Energy

Dr. Ahmad Kamal Hassan

Assistant Professor

Ph.D, King Abdulaziz University, Kingdom of Saudi Arabia

Specialization: Electrical and Computer Engineering

Research Interests: Telecommunication, Wireless communication, Statistical aspects of Communication Theory, Signal Processing, Advanced ASICs Design

Dr. Muhammad Muqet Rehman

Assistant Professor

Ph.D, Jeju National University, South Korea

Specialization: Mechatronics Engineering

Research Interests: Fabrication and characterization of electronic devices; Memristors, RRAMs, Transistors (TFTs), Organic Light Emitting Diodes (OLEDs), Sensors, Photo Transistors, and Nano generators

Faculty of Engineering Sciences

Dr. Jameel-Un Nabi

Professor

PhD, University of Heidelberg, Germany

Specialization: Physics/Applied Physics

Research Interests: Nuclear Astrophysics, Renewable Energy Resources, Optical Engineering

Dr. Muhammad Hassan Sayyad

Professor

PhD, Applied Physics, Dublin City University, Ireland

Specialization: Inner shell photo absorption studies in free atoms and ions using dual laser plasma techniques

Research Interests: Computational design, synthesis and characterization organic semiconductors for optoelectronic and photonic applications, Investigation of conjugated organic materials for the fabrication of electric, electronic and photonic devices including organic jun

Dr. Ghulam Shabbir

Professor

PhD, University of Aberdeen, Scotland, UK

Specialization: Symmetries in General Relativity

Research Interests: Symmetries in Teleparallel theory of gravitation, Heat Transfer and Phase Transformation, Noether's Symmetries and Conservation Laws and Symmetries in $f(R)$ and $f(R, T)$ theory of gravity.

Dr. Habibullah Jamal

Professor, Fellow IE, Pak, Fellow IEEE, Pak

PhD, University of Toronto, Canada

Specialization: Electrical Engineering

Research Interests: Digital Design and Signal Processing

Dr. Bakhadir Irgaziev

Visiting Professor

PhD, Moscow State University, Russia

Specialization: Mechanism of nuclear reaction at low energies

Research Interests: Nuclear astrophysics, few body problems

Dr. Sirajul Haq

Professor

PhD, University of Liverpool, UK

Specialization: Mathematical Models of Defects in Discrete Lattice Structures

Research Interests: Numerical Analysis; Analysis of Non-Local Lattice Models and Applications in Dislocation Theory;

Dr. Muhammad Zahir Iqbal

Assistant Professor

PhD, Post Doctorate. Georgia State University, USA,

Ph.D in Physics, Sejong University, South Korea,

Ph.D in Computational & Applied Physics, Universitat Politècnica de Catalunya, Spain

Specialization: 1. Quantum transport and spin tunneling in two-dimensional layered heterostructures.

2. Structural and electrical characterization of doped graphene and carbon nanotube networks

Research Interests: Solar Photovoltaics & Fuel Cells, Electronic & Quantum Device Engineering, Spintronics, Optoelectronics, Experimental Condensed Matters Physics, Materials Chemistry, High Frequency Device Applications

Dr. Tahseen Amin Khan Qasuria

Assistant Professor

PhD, Electronic Engineering, GIK Institute of Engineering Sciences and Technology, Topi, Distt: Swabi, Khyber Pakhtunkhwa, Pakistan

Specialization: Semiconductors, Sensors Fabrication, Telemetry Systems, Electronic Devices Fabrications

Research Interests: Modeling of Organic Semiconductors Devices, Fabrication of Humidity, Light, Temperature and Displacement Sensors for the Telemetry Systems Applications, Fabrication of the Diodes, Transistors, Memory Elements and Charge Storage Devices.



Dr. Dur-e-Zehra Baig

Assistant Professor

PhD, Electrical Engineering from University of New South Wales, Sydney, Australia

Specialization: Physiological control of human heart rate and oxygen consumption during rhythmic exercises

Current Research Interests: Data acquisition and distribution systems; System control; System identification; Signal processing; Biomedical instrumentation; Biomedical system modeling and control; and Computer Architecture. Temperature and Displacement Sensors for the Telemetry Systems Applications, Fabrication of the Diodes, Transistors, Memory Elements and Charge Storage Devices.

Dr. Muhammad Usman

Assistant Professor

PhD, Hanyang University, South Korea

Specialization: Modeling and Characterization of light-emitting diodes

Research Interests: Photonics, Light-emitting diodes, III-N materials



Faculty of Materials and Chemical Engineering

Department of Materials Science and Engineering

Dr. Ashraf Ali

Professor

PhD, University of Cambridge, Cambridge, UK

Specialization: Metallurgy and Materials Science**Research Interests:** Nanomaterials, Biomaterials, Failure Analysis, Magnetic Materials, Superalloys**Dr. Fazal Ahmed Khalid**

Professor

PhD, University of Oxford, U.K

Specialization: Metallurgy and Materials Science**Research Interests:** Processing and characterization of materials, Nanotechnology, Nanomaterials**Dr. Fida Mohammad**

Associate Professor

PhD, Univ.California, Davis.U.S.A

Specialization: Reaction dynamics**Research Interests:** Atmospheric Chemistry**Dr. Yasir F Joya**

Associate Professor

PhD, The University of Manchester, UK

Specialization: Nanomaterials, Nano Characterization, Biomaterials**Research Interests:** Functional materials, 3D printing, biomaterials, corrosion and degradation**Dr. Fahd Nawaz Khan**

Associate Professor

PhD, Northumbria University, Newcastle Upon Tyne, UK.

Specialization: Maching of Aerospace alloys**Research Interests:** Bandsawing of high performance Titanium and Nickel alloys..**Dr. Muhammad Imran Khan**

Assistant Professor

PhD, University of Tsukuba, Japan

Specialization: Smart Materials**Research Interests:** High Temperature Smart Materials, Biomaterials, Martensitic Transformation, Nanoscale Precipitation**Dr. M. Ramzan Abdul Karim**

Assistant Professor

PhD, Politecnico di Torino, Italy

Specialization: Composite Materials**Research Interests:** Ceramics and Composites; Nano-composites and coatings; Materials for energy storage devices, Corrosion evaluation of metals, alloys and metal matrix composite; Study of possible measures for corrosion prevention; Degradation of Polymers and Polymer matrix composites.**Dr. Rashid Ali**

Assistant Professor

PhD, Roma Tre University, Rome, Italy

Specialization: Modeling and characterization of hard coatings for mechanical application**Research Interests:** Multilayer PVD-Coatings used for Mechanical Applicatinos, Residual stress analysis, Multilayer hard coatings, Modelling and Characterization of Thin films, Failure Analysis.**Dr. Syed Zameer Abbas**

Assistant Professor

PhD, GIK Institute of Engineering Sciences Technology, Topi, Pakistan

Specialization: Bulk Metallic Glasses, Advanced Materials**Research Interests:** Electron Microscopy, Advanced Materials, Amorphous Materials

Faculty of Materials and Chemical Engineering

Department of Chemical Engineering

Dr. Javaid Rabbani Khan,

Professor

PhD, University of New Castle upon Tyne, UK,

Specialization: Heat Transfer,

Research Interests: Heat Transfer Augmentation

Dr. M. Shozab Mehdi

Assistant Professor

Pakistan Institute of Engineering and Applied Sciences

Specialization: Multiphase Chemical Reactors

Research Interests: Hydrodynamics and Mass Transfer of Multi-phase flow

Dr. Khurram Imran Khan

Assistant Professor

PhD, Politecnico di Torino, Italy

Specialization: Multiphase Chemical Reactors.

Research Interests: CFD Modelling of multiphase

flows, Mass Transfer, Reaction engineering, Carbon Capture

Dr. Sajjad Hussain

Assistant Professor

PhD, University of Sao Paulo, Brazil

Specialization: Environmental Electro chemistry

Research Interests: Preparation of magnetic nanoparticles modified with molecular imprinted polymer (MIP) for determination contaminants in environmental and food sample

Dr. Muhammad Usman Farooq

Assistant Professor

PhD, University of Waterloo, Waterloo, ON CANADA

Specialization: Membrane Separation, Adsorption

Research Interests: Separation of heavy metals from water using fibroin as adsorbent.



Faculty of Mechanical Engineering

Dr. S. M. Ahmad

Professor

PhD, University of Sheffield, UK, CEng, MIMechE

Research Interests: Mathematical Modelling and Control Systems Engineering of Dynamical Systems. Systems of research interest are unmanned air and underwater vehicles, active magnetic bearings, rotordynamics, FEM and robotics.

Dr. Wasim Ahmad Khan

Professor

PhD, University of Sheffield UK, CEng, FIMechE

Research Interests: Virtual Reality, Virtual Manufacturing, Operations Research, Education Management

Dr. Mykola Bannikov

Professor

PhD, USSR

Research Interests: Performance and emissions of IC engines. Modelling of engine processes. Alternative fuels.

Dr. Khalid Rahman

Assistant Professor

PhD JEJU National University South Korea

Research Interests: Inkjet Printing, Printed Electronics, Thin Film Deposition, Nano and Micro-fabrication, CAD, CAE, ANSYS

Dr. Taqi Ahmad Cheema

Assistant Professor

PhD, Kyungpook National University, South Korea

Research Interests: Fluid-Structure Interaction, Hemodynamics, PIV, CFD Applications, Multiphysics Simulations (FSI, TSI)

Dr. Sohail Malik

Assistant Professor

PhD in Mechanical and Management Engineering (Università Politecnica delle Marche, Italy)

Research Interests: Instrumentation and Measurement, Finite Element Analysis, Laser-Ultrasonics, Reliability Analysis, High Speed Train Axles Inspection, Energy Audit, Energy Harvesting, Earth Quake Warning Systems, Multi Body Dynamics

Dr. Muhammad Asif

Assistant Professor

PhD, Hanyang Univeristy South Korea

Research Interests: Integrated gasification combine cycle (IGCC), Biogas production and purification, Water purification

Dr Muhammad Ilyas

Assistant Professor

PhD, ISAE-SUPAERO, University of Toulouse, France

Research Interests: Fiber Epoxy Laminated Composites, Damage Mechanics and Modeling, Application of Finite Element Analysis, Rapid Dynamics, Impact, Crash

Dr. Adnan Hassan

Assistant Professor

PhD (Koç University, Istanbul, Turkey)

Research Interests: Design and Drive of Electrical Machines, Analytical and FEM Simulations of Electromechanical Systems, Linear Actuator Design and Analysis

Department of Management Sciences

Dr. Muhammad Sabir

Assistant Professor

Qualifications: PhD (Vrije University Amsterdam, The Netherlands)

Specialization: Economics

Research Interests: Microeconomics, Microeconometrics, Applied Econometrics, Transport Economics

Dr. Noor Muhammad

Assistant Professor

Qualifications: PhD (University of Huddersfield, UK)

Specialization: Management (Entrepreneurship)

Research Interests: Entrepreneurship, Small Firms Growth and Global Business Environment, Social Entrepreneurship, Technological Entrepreneurship, Entrepreneurship in Conflict Zones

Dr. Cedric Aimal Edwin

Assistant Professor

Qualifications: PhD Business Management (Liverpool Hope University, UK)

Specialization: Management (CSR)

Research Interests: Corporate Social Responsibility, Corporate Strategy, Sustainable Business Models, Technology Management, Training and Development, Performance Appraisals, Innovation in Education, Qualitative Research (grounded theory, phenomenology)

Dr. Mian Muhammad Atif

Assistant Professor

Qualifications: PhD (Massey University, New Zealand); MBA - Finance; PGDip in Management

Specialization: Management (Finance)

Research Interests: Corporate Finance, Corporate and Institutional Governance, Qualitative Research in Finance and Critical Finance/Management Studies

Dr. Sajjad Nazir

Assistant Professor

Qualifications: PhD (Hohai University, Nanjing, China)

Specialization: Human Resource Management

Research Interests: Human Resource Management, Organizational Behavior, Organizational Commitment, Rewards, Compensation and Innovative Behavior

Dr. Yousaf Ali Khan

Assistant Professor

Qualifications: PhD (Quantitative modeling practices in Economics and Management) (Italy)

Specialization: Economics and Management

Research Interests: Operations Research, Input-Output Analysis, Policy Modeling, Impact analysis, Inoperability input output modeling, Disaster Risk Management, Operations & Production Management, Linear Programming, Environmental economics, Energy economics,

GRADUATE ALUMNI

The institution has so far produced 367 MS and 61 Ph.D Graduate who are serving in national and international organizations.



Studying at GIK institute was one of the most pleasant educational experience I had. The institutes environment along with research facilities were quiet exceptional. I feel honored to be a graduate of GIK institute and would highly recommend pursuing a graduate degree program at GIK institute to prospective students looking forward for seeking an advanced degree in engineering.

Sarmad Feroze (2016)



GIK is one of the best schools to be in when you are pursuing your graduate course in Pakistan. At GIKI, the academic culture (teaching and research) have an international outlook and the faculty is up-to-date with the current global scholarly ideas. The state of the art and well maintained teaching and research facilities help students to gain knowledge and nurture ideas in best possible ways. The faculty not only provide scientific knowledge but also mentor the pupils to discover their best capabilities and prepare them for future leadership roles for both academic and industry. **Dr. Shahid Rasul (2005)**



GIK is a place where you will experience best time of your life. This place is phenomenal, and one of the beauty is that the location cannot be compared with the top tier universities in Pakistan. Throughout your academic life here, you meet with different people, the artist, the innovators, the genius, the lazy ones, the leaders & the thinkers. From all these people you learn a lot. 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. **Jamal Hussain (2016)**



Joining GIKI for graduate studies was honestly the best decision of my academic career. It's a prestigious institute with innumerable academic, research and social grooming opportunities. GIKI's familial environment and sense of community distinguishes it from other universities. I have met so many fantastic people here, who I am glad to call as mentors, peers and friends. The two years spent at GIKI was the most rewarding time of my life. **Syed Ehtisham Gillani (2016)**



GIK institute is a place that provides the best research environment to its graduate students. The best thing about this institute is that it grooms its students and opens a new horizon in the field of Engineering and management. Getting an MS degree from GIK institute is no difference than getting one from a world class foreign institute. Thank you GIK institute.

Shaukat Khan (2017)



GIKI is a complete package of social and professional life for graduate students. It is, undoubtedly, a challenging environment: during days, you will be studying courses and instructing the undergrads in labs; in evenings and even at nights, you will be passing time in doing experiments. Nonetheless, it's a freedom too: in weekends you'll be sitting in a concert and enjoying many other wonderful events of GIKI societies. It is, in short, the best experience of my life; at the end of my journey, I published my research in reputed journals, secured admission in the very best places in the world, and will be moving to the dream place very soon.

Muhammad Akmal (2015)



The courses delivered have strong practical aspects which mean that one not just memorize engineering theories but learn how they can be successfully applied. Further, the strong research environment develops strong analytical, technical and problem solving skills. Even now if I come across a problem in my job, I make use of skills learnt during my masters to provide an effective solution.

Muhammad Haseeb Hassan (2012)



During my postgraduate studies at GIKI, I witnessed the great utilization of available resources at the campus. Experienced and hardworking faculty working on innovative research projects is the asset of GIKI. Along with the academic activities, the extracurricular activities round the year keep you afresh for research.

Mujahid Hussain (2014)



Giki is indeed one of the best place to study in. Specially, the experience of being a graduate student as well as a faculty member is awesome. It really makes feel confident to compete in a competitive environment. Moreover, the faculty members have always been nice and cooperative. I am proud of having its tag.

M. Mussawer Pervez (2016)



Being a part of both BS and MS programs, GIKI instilled confidence in me that I would, one day, become a leading researcher who'd be capable of developing technologies and making a difference. This remarkable institute polished and helped me to accomplish my goals through its rigorous and challenging academic system. The high standard of quality and excellence of GIKI is reflected in my work because GIKI has a capability of turning coal into diamond. After spending 6 years at GIKI, my several papers have been published in reputable journals. Other than academics, this institute has given me lifelong bonds with my classmates and Teachers.

Engr. Muhammad Waqas (2016)



Coming to GIK has changed my life in so many ways. GIK experience is larger than the academic and co-curricular worth it offers for it gives you an exclusive opportunity to self-discover and to re-invent your "self". The professional and eminent faculty transforms an ordinary student into a confident, mature and skillful person. Beyond this, GIKI broadens your vision and provides a dynamic approach to practical life.

Tahir Sattar (2014)



My stay at Giki was remarkable, GIKI provides a healthy environment for research with highly qualified Faculty. I am always thankful to Allah SWT and GIKI for providing full scholarship and opportunity to serve as a Graduate Assistant. During my Masters, I participated in three international conferences in which one was in Atlantic City, USA. Furthermore, my two research papers are under review process.

Muhammad Abdullah Khalid (2017)



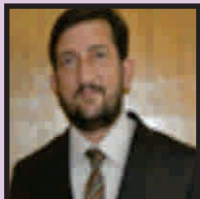
I found GIKI an optimum place for grooming and enhancing my research capabilities during my MS studies. Graduate Assistant-ship duties provided a close capture of faculty members, resulting in a deep understanding of becoming an effective part of leading education institutions. I think if you get the chance

Sayyar Ahmad (2017)



I graduated from GIKI in 2017, and life at GIK Institute was phenomenal. In a nutshell, GIKI will help you a lot to come out of your comfort zone. Being (literally) present in the middle of nowhere, campus life over the two years at the university will mold you into a much more independent, mature and responsible person.

Iqra Kiran (2017)



Before coming to GIKI I found the idea of University a little daunting. However, after the first semester in GIKI I wondered why I had worried. As a mature student, 'fitting in' was a major concern for me. However, I have never been made to feel out of place either by staff (even though I am as old as some of them) or by my fellow students. I have made new friends and got to know people I would never otherwise have had the opportunity to meet. I have never regretted joining the University and am now seriously considering postgraduate study here. I would recommend it to anyone.

Fazal Muhammad (2017)



Ghulam Ishaq Khan Institute of Engineering Sciences and Technology (GIK) Topi Swabi KPK is one the best institutions of Pakistan. I got my PhD degree from Faculty of Engineering Sciences in 2017. During my studies here, I experienced a wholesomely affable environment for study and research. Besides the best quality of teaching staff and facility wise rich hostels, I found fully equipped labs, cooperative technical staff and Intact security system. Not even a single day, during my studies here, I felt uneasiness but only to face the hardships of my research work. I am thankful to the honorable Rector and Pro-Rector Dr. Jameel-Un Nabi (my supervisor) and the whole administration.

Dr. Muhammad Fayaz (2017)

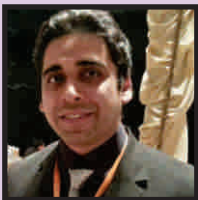
GRADUATE STUDENTS IMPRESSIONS



Doing PhD on Full Scholarship from a prestigious institute was the ultimate dream of my life. ALHAMDULILLAH! I'm living this dream today at GIK under the supervision of best mentors like Dr. Ghulam Abbas and Dr. Zia ul Haq Abbas. Also, I feel blessed and energized being an active member of TeleCoN Research group as it helps in progressing in Ph.D.

GIK Institute has the tendency to flourish its students and nurture their talents to shine more exquisitely.

Laila Khalid (2017)



Working on my PhD in the Faculty of Computer Sciences and Engineering, GIK Institute has been such a rewarding experience. The faculty challenges students to be independent, creative researchers and supports their growth in this role. My graduate school experience thus far at GIK Institute has been extremely pleasant. I have been constantly challenged and provoked to think of new research ideas. Specifically, the Computer Science faculty encourages their graduate students to rise beyond their daily comfort zones.

Alamgir Naushad (2014)



I rank GIK Institute as one of the finest Institutes in Pakistan as far as quality of research and education is concerned. One can name GIK as "Knowledge Park" in a calm environment where you have ample time to focus on your curricular and extra-curricular activities.

Muhammad Mehran Bashir (2017)



When it comes to pursuing PhD choosing the right university is utmost important and GIK Institute have all what it takes to be an ideal choice for a doctorate study. Since I joined GIK Institute as a PhD fellow/Graduate Assistant, I am continually impressed with their top faculty, high-tech labs and university's versatile and vibrant environment. The location of Institute at nature-rich country side also makes it very suitable for innovation and deep research.

Zahra Andleeb (2018)



GIKI had always been my first choice to pursue my graduate studies because of its quality research labs and research groups involved in up to date research. Being a PhD fellow (TeleCoN Research Lab) in the faculty of Electrical Engineering at GIKI, I found it not only been an excellent source of a quality education but is also committed to quality and standard research. The highly qualified faculty member and researchers are very cooperative, enthusiastic, caring and are always willing to help and guide the students in their research projects. GIKI has international collaboration with the world top research labs and researchers which help the students to update their knowledge in their respective area of interest and get international exposure working jointly with foreign researchers.

Arif Ullah (2017)



Competitive coursework coupled with graduate assistantship at GIK gave me head start in academia and provided me with unique environment to develop my academic, social, and Intellectual repertoire. The scholarly, logistical, and financial support that I received from GIK is something for which I am forever indebted to.

Safi Ahmed (2015)



During my postgraduate studies I am fortunate to have the support of the GIK and my family. I am truly grateful for the guidance and support offered by the lecturers or professors who got to know us on a first name basis; I could knock on the door of any of the lecturers or professors, and they always responded to my queries. You'll always feel there's somebody for you when you need them, that is why GIK is so special. I could recommend GIK highly enough.

Muhammad Umar (2018)



GIK has not only bestowed me with immense opportunities to learn from numerous talented researchers but has also given me the chance to network with like-minded people. Throughout my stay at GIK, it has instilled a sense of pride, confidence and self-motivation in me. It not only teaches students about theoretical concepts but also prepares them for the problem they are to face in real world. Through this commitment and hard work, GIK motivates its students to be the best option for shaping the future of Pakistan. **Suddiyas Nawaz (2016)**



The majority of fully funded MS options that I came across have no experience opportunity (Assistantship) for bright career of the candidate. This was very beneficial to me to continue my study with teaching experience which improves my confidence level. I'm enjoying my time at GIKI because of the sense of community and social cohesion. It is very normal practice to just knock on professor door and say, "Hey, can I talk to you about my problem."

Muhammad Sulaiman (2017)



I found GIK Institute to be most prestigious, and organized research oriented institute of Pakistan. By breaking stereotype, it has provided equal opportunities for girls in Engineering. I can proudly say that I am a graduate of GIK Institute and I strongly recommend it for pursuing higher studies.

Ammara Tofique (2017)



GIKI offers you something that very few other institutions can; It gives you confidence, exposure, proper grooming and skills required for a successful future. The open, adverse, challenging and yet welcoming on-campus environment makes you work like a beaver and think like a champion. The essence of GIKI is the challenges you face psychological, personal and professional every single day, forcing you to believe in yourself. As a Graduate student, I flourished every moment I spent in GIKI.

Kifayatullah Bangash (2017)



As a postgraduate student, what I felt is the GIK students are self driven and ambitious, but also highly engaged with the world around them and deeply concerned about making an impact by quality of research they are seeking. GIK provides an ideal foundation for many careers. I could knock on the door of any of the professor, and they always responded to my queries.

Muhammad Asad (2017)



Life in Ghulam Ishaq Khan Institute of Engineering Sciences and Technology (GIKI) is all about the entertaining scene, Study in a wide and full reference library, walks in the parks, playing in sport complex and supporting some of the professional sport teams as teaching staff. Take pictures of the Audi, library and the design of the hostels are the most iconic buildings in KPK.

Waqas Ali (2017)



Coming to GIKI for my Graduate studies was probably the best decision I could have made. In GIKI, not only I learned professional skills but my personality groomed in other aspects as well. My journey in GIKI began one and half year back in Sep 2016. Life here is a totally different experience and it provides an enthusiastic Research environment for graduates due to 24/7 open door policy of Faculty. The conduct of faculty members is appreciable. This amazing experience to be a part of such a prestigious institute will definitely play an important role in the beginning of my professional career.

Khadija Khan (2016)



GIK plays a vital role in your academic and natural development. Having done Bachelors from here, it compelled me to pursue my Masters from here too. The reason is simple, it's because of the world-class facilities and the great social life of GIK that tends to groom you and takes the very best out of you. Proud to be a GIKIAN.

Amin Ullah Khan (2018)



It was a great and memorable experience for me as a graduate student in GIK Institute. The great thing about GIKI is, it is a residential campus and friendly environment. As far MS degree program is concerned, there is a lot of learning for you as a graduate student because of the experienced faculty of Computer Science and Engineering department.

Raja Usman Ahmed Khan (2016)



I believe the thing that I really appreciate in GIK Institute and is fairly unique is the strong interconnectedness of different disciplines and different research areas; particularly in a field like mine, Engineering Management. GIK Institute offers a high quality masters program which allows me to immerse myself in the studies both academically, personally and professionally.

Muhammad Waseem Khan (2017)



Working on my PhD in the field of computational mathematics (Wavelets) at GIK Institute has been such a great experience. There are lots of opportunities to build skills in science writing. I thoroughly enjoyed my graduate and teaching experience. The excellent guidance from faculty members, especially numerical analysis group and resources accelerated my development in computational mathematics.

Abdul Ghafoor (2015)



GIK Institute is one of best Institute in Pakistan offers a very open and engaging environment that fostered my analytical and scientific skills. There are ample resources to support the graduate programs offers here, and I value the quality of scholarships at GIK where the primarily focus is on creativity and innovation in research.

Manzoor Hussain (2016)



From the first week at GIK Institute you feel that it is necessary to sweat for training, but it is seen more as an opportunity to achieve something rather than burdensome work. Moreover, the teachers are friendly, try to interest in the subject, and indulgently belong to the amazed graduate students. I can speak about GIK Institute only with a smile. Despite the big territory, uncountable number of buildings and students, you feel yourself at home, you are a particle of this huge organism. I will never exchange GIK Institute to other universities. **Abdul Muneem (2018)**



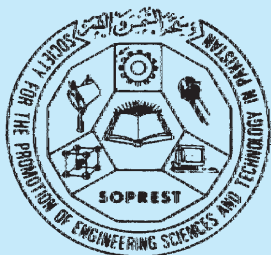
It's difficult to sum up the memories and experience of two years in few lines. I consider myself very lucky for being a part of GIK which is no doubt one of the best Engineering Institute of Pakistan. The on-campus environment is something special which made us study and enjoy co-curricular activities. All the professors are very helpful and they guided us all the time. Different events and sessions arranged have boosted my confidence to a great extent. Participating and organizing events of festivals and sports gave me a different enjoyable experience. These two years have given me friends for life. It has been an unforgettable journey. I have spent my wonderful days of life in GIK. **Hafeez ur Rehman (2017)**



I knew I had to choose an institute for my masters that offer finest faculty, constructive learning, challenging environment and energetic social life and GIK was the place for me. Life here is so happening and the diverse cultural exposure makes the stay at GIK a unique experience. The best thing for me was being associated with Faculty of Chemical Engineering i.e. filled with wonderful people, who supported me in all the ways possible and I am immensely grateful for that.

Amna Bashir (2017)

SOPREST OFFICE



Engr. Shams ul Mulk, HI
President SOPREST

Shakil Durrani
Executive Director SOPREST

Mushtaq Ahmad Khan
Secretary SOPREST and BoG



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Director ORIC

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Principal, GIK College

Abdul Qadeer Awan
email: principal@giki.edu.pk

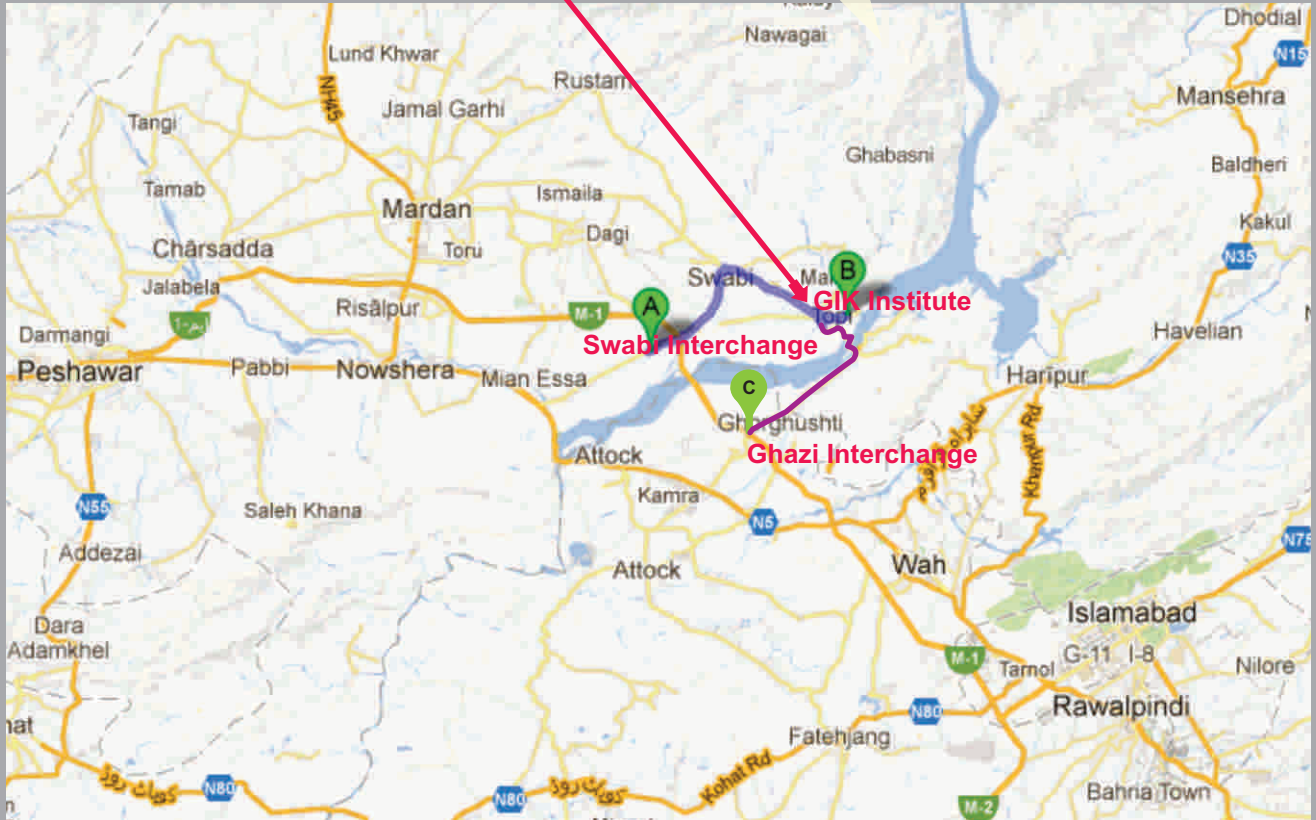
Graduate Admissions Officer

Ismatullah Khan
email: gadmissions@giki.edu.pk

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 towards 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 services 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 procedures, to observance of the Act, Guidelines, Rules and Regulations of the Institute.

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