University of Engineering and Technology Peshawar is privileged to enjoy its place as a premier seat of learning amongst the reputed engineering universities of Pakistan. It is basically on account of opportunities that are provided to our youth coming from far flung areas who attain quality education at an affordable cost.

It is indeed a matter of great satisfaction for me that this institution is known as an engaged university and bring significant improvement for imparting higher education in Khyber Pakhtunkhwa. Innovative research in conventional disciplines to the new scientific initiatives in artificial intelligence has recently been introduced which will greatly help to cultivate an atmosphere essential for acquiring a high academic standard.

I realize that the prominent pillars of a university are the students, teachers and staff therefore, building teamwork through a common vision and working together would certainly make a perceptible difference in the growth and progress of the University. It is commendable that the University has created this sense of unity and a conducive culture for the students to update their knowledge in various scientific disciplines while adhering to our moral values. As Chancellor, I am confident that such efforts will continue in future with a greater zeal.

I wish the new entrants to be able to fully benefit from the emerging up-coming academic and research advancements and make themselves, truly productive assets of the nation in the time to come.

Engr. Iqbal Zafar Jhagra
Governor Khyber Pakhtunkhwa
Message from the Vice Chancellor

University of Engineering and Technology, Peshawar is one of the premier institutions of Pakistan and pursues a great deal of oversight for research and development in engineering field. The highly competitive postgraduate program of UET Peshawar covers a wide range of disciplines in engineering however, our main thrust is to pursue state of the art research in the field of renewable energy, earthquake engineering and sustainability. Through a robust M.Sc. and Ph.D. program, we are continuously working towards creating impact of our indigenous research in the society. It is only possible when we are able to show the value of work that is done by our researchers, students and faculty. For this reason, we foresee a competitive process in selection of candidates who apply to our postgraduate program.

UET Peshawar's institutional linkages established with local industry and technical assistance that our faculty provides to the policy makers are a healthy sign of our increasingly engaged role and we are striving to further deepen these partnerships to the community level. Most of the research at UET Peshawar is carried at our centers of excellence where our high qualified faculty and postgraduate students work closely with partnering institutions and find real life solutions. To name few, the Center for Intelligent Systems and Network Research's (CISNR) is directly engaged in CPEC projects and has worked tremendously in finding solutions for electricity theft through smart metering; Earthquake Engineering Center is strategically involved with Government in the field of seismology and the U.S.-Pakistan Center for Advanced Studies in Energy is serving as "energy think tank" for the Government of Khyber Pakhtunkhwa shows confidence on us and in-depth research carried by very able researchers. In this scenario, we will make every effort to expand this role and make it more valuable for the society.

As the Vice Chancellor of UET Peshawar, I welcome you all and urge you to come up with research goals clearly as the moment you get enrolled here, you will be asked to start working towards your idea through lab research and justify its application in the market. That's how I visualize UET Peshawar as a highly engaged university in future. Let’s get started and take a step forward.

Prof. Dr. Iftikhar Hussain
Vice Chancellor, UET Peshawar
UET strives to provide admission related information to potential students. The following departments respond to various queries regarding selection of academic disciplines, admission schedule and important dates etc.

www.uetpeshawar.edu.pk
UEET website has information on undergraduate and postgraduate courses, with helpful advice on selection of disciplines. Latest news and updates are regularly published on our website.

Directorate of Postgraduate Studies
The Directorate of Postgraduate Studies (DPGS) deals with admissions of postgraduate students in coordination with Directorate of Admissions. The Directorate also looks after the processing of postgraduate programmes and enforcement of regulations approved by the Academic Council and Syndicate.
Contact: (+92-91) 922 2151
khanshahzada@uetpeshawar.edu.pk

Directorate of Admissions
The Directorate of Admissions is responsible for student admissions; provides specific and general information to prospective students round the year.
Contact: (+92-91) 9216784
website: www.enggentrancetest.pk E-mail: admission@uetpeshawar.edu.pk

Directorate of Media and Publications
The Directorate of Media and Publications is responsible for media activities and in-house publications. It runs an extensive admission publicity campaign; circulates admission schedules, important information, announcements, news releases and advertisements.
Contact: (+92-91) 9222147
E-mail: dirmedia@uetpeshawar.edu.pk

IT Center
Campus Solution is the only administrative setup available today that provides students, alumni, faculty and staff with immediate access to real-time information and connects that information to specific action. It provides a platform for effective administration of students academic life cycle with the facility to have 24/7 access to information and services.
National Institute of Urban Infrastructure Planning (NIUIP)
National Institute of Urban Infrastructure Planning (NIUIP), established in 2008 with Higher Education Commission (HEC) funding, is committed to promote sustainable urban development in Pakistan, and apply research in combating challenges facing rapidly growing urban centers in the country.

Objectives:
- To develop it into a center of excellence for teaching, research and training in urban infrastructure planning in Pakistan.
- To train and educate Masters’ and Doctoral level students with hands-on opportunities for research in an applied and problem-solving environment.
- To conduct research in emerging trends in urban planning and development.
- To identify and disseminate global best practices in urban planning and management.
- To develop national and international strategic partnerships for collaborative research.
- To train in-service professionals in government and non-government organizations in urban infrastructure planning.

Continuing Engineering Education Center (CEEC)
CEEC ensures need-based trainings to the engineering community as a part of continuing engineering education to in-serve engineers. The Center has been established with following objectives:

- Capacity building of engineers to engage effectively in the global economy.
- Development of indigenous capacity to ensure effective utilization of international aid.
- Promote quality of teaching and research.
- Improve project management and financial management skills.
Besides serving the engineering community in general, CEEC regularly offers Teachers Training courses in collaboration with HEC for its freshly inducted faculty.

**Technology Incubation Center (TIC)**
Technology Incubation Center established with the help of HEC is aimed to spur economic development and job creation through technology business incubation. The Center offers support services for start-up entrepreneurs in starting and running their businesses. Besides, it also facilitates the faculty and students in obtaining Intellectual Property Rights as well as commercialization of their research. The center is fully equipped with allied facilities, offers one roof solutions including, phone, internet connectivity, video conferencing and trainings on IP and legislative matters under the qualified faculty and staff. It also aims to attract young brains to commercialize their innovative ideas and for this purpose the Center incubates small companies, selected through a supervisory committee.

**Gems and Jewelry Center of Excellence (GJCoE)**
The Gems and Jewelry Center of Excellence Center is a state-of-the-art facility in gem cutting and polishing. The center with its qualified teaching faculty and laboratories offers five month diploma in gemology and lapidary. The Center has been upgraded to Gems and Jewelry Center of Excellence that will not only provide training in gemology and lapidary, but value gems and precious stones.

**Earthquake Engineering Center (EEC)**
UET Earthquake Engineering Center is a multi-disciplinary research and education Center, established with the aim to mitigate the seismic disaster risk in the province in particular and country, in general. The center has made tremendous progress so far in the last few years. It has been upgraded to the National Institute of Earthquake Engineering with the funding of Rs. 487.219 million by HEC. The center has developed research collaborations with renowned international organizations, research centers and universities for human resource development, research and development activities.

**Quality Enhancement Cell (QEC)**
The Quality Enhancement Cell (QEC), is aimed to assist the university in improving the student learning by continuously enhancing and maintaining the academic standards under the HEC guidelines. At present, the QEC efforts are mainly
focused on coordination between the university and HEC, and implementation of the HEC quality assessment procedures. Since its establishment in February 2007, QEC has focused on gathering information and data about the facilities, finances, research, students, and faculty of each department and, has incorporated the collected information in the HEC ranking performa as per HEC requirements.

**Office of Research, Innovation & Commercialization (ORIC)**

UET Peshawar has developed the Office of Research Innovation & Commercialization (ORIC). This office is aimed at transforming pure knowledge into products and services with the perspective of ultimate community welfare. Its main role is to strengthen University's research and knowledge creation process by providing strategic and operational support through promoting entrepreneurship, technology-transfer and commercialization activities to energize local and national economy. It also aims at strengthening University-Industry relationships by enhancing cross-cutting and multi-disciplinary research initiatives for the up gradation of local and national industries. In general it aspires to achieve sustainable development by translation of research into public benefit through ensuring research relevance in terms of social, economic and environmental aspects.

**Center of Intelligence Systems and Network Research**

The Center of Intelligence Systems and Network Research (CSINR) was launched at Electrical Engineering Department. The Center presents an example of industry-academia linkage, established with the active participation of faculty of Electrical Engineering Department.
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THE UNIVERSITY

University of Engineering and Technology, Peshawar, is a premier institution of higher learning in the field of engineering sciences. Starting as a College in 1952, with an initial enrollment of only twenty students, today it boasts twenty two engineering departments, covering an entire spectrum of engineering disciplines, from the traditional, such as electrical and mechanical, to the cutting-edge technologies such as electronics, mechatronics, and industrial engineering. To-date, thousands of students that graduated are serving the needs of Pakistan, and many have achieved high positions of responsibility and excellence in their chosen fields.

Besides bachelors degree courses, there is a robust post-graduate programme, where scholars are engaged in rigorous training and research leading to Master’s and Ph.D degrees. UET also has a strong out-reach programme, under which academic linkages with the world class universities of UK, Canada, USA, Malaysia, Italy and Thailand offering invaluable training to faculty and students, through split programmes, joint research and faculty exchanges.

Over the last few years, with Higher Education Commission's support, UET had initiated a number of research and infrastructure development projects, with a portfolio of Rs. 9 billion. Major projects include “Earthquake Engineering Center”, serving as a hub of applied research in South Asia, “Institute of Mechatronics Engineering”, “National Institute of Urban Infrastructure Planning” and “Gems and Jewelry Center of Excellence”.

In order to increase access to engineering education, particularly for the people of Khyber Pakhtunkhwa, UET has been awarded a “mega” project of Rs. 6.56 billion to develop a new campus called, “Establishment of Jalozai Campus.” The Jalozai Campus promises to push boundaries for engineering education and will double its student intake from 4000 to 8000.

PESHAWAR CAMPUS

With a modest beginning in 1952 as a “constituent” college of Peshawar University, UET, Peshawar was established in 1980. Since then, five satellite campuses in Mardan, Bannu, Abbottabad, Kohat and Jalozai have been added. We have also established centers of excellence and institutions. However, Peshawar Campus remains the nucleus of the University, keeping everything moving along the correct path.

Located in the historic city of Peshawar, UET is a reflection of the surrounding environment. While the ambiance on campus is predominantly academic, there is a strong cultural flavor, easily discernable in every facet of its activities. Our unique cultural diversity is readily recognizable.

There are many disciplines at Peshawar for students to choose from. These are supported by well-equipped laboratories, departmental research, and a central library, sports facilities and enough dormitory accommodation to house most students that need campus housing.
SATellite Campuses

Abbottabad Campus

The Chancellor, UET, Peshawar inaugurated Abbottabad Campus in October, 2002, in the old premises of Ayub Medical College. The city of Abbottabad gained fame as a city of schools and colleges. Due to a pleasant climate, people from all parts of the country send their children to study in reputed educational institutions such as Army Burn Hall, Abbottabad Public School, COMSATS Institute of Information Technology etc. In addition, five medical colleges in the city also attract students. Establishment of a campus of UET, Peshawar in Abbottabad has not only addressed a longstanding public demand, but also enhanced the city's image as a seat of learning. Known for its natural beauty, better climatic conditions and a vast network of educational institutions, Abbottabad was ideally suited for such an institution of higher learning in applied sciences. A new girls hostel with a capacity to accommodate hundred students has been constructed at the campus.

Bannu Campus

Bannu Campus became operational in May 2002, in the premises of the Comprehensive High School in the city. This has brought higher education in engineering sciences to this neglected middle-southern region. Prior to this, students would go to Dera Ismail Khan, Kohat or Peshawar to pursue their higher studies.

Currently, two traditional disciplines in engineering sciences are offered, and efforts are afoot to consolidate these programmes. Large investment in strengthening laboratories, and upgrading infrastructure are being done to quickly bring this campus at par with others.

Kohat Campus

The administrative and management control of Engineering Academic Programmes of Kohat University of Science and Technology (KUST) was handed over to UET, Peshawar on April 3, 2012. At present, UET Kohat Campus is offering B.Sc. electrical engineering in leased premises, providing all necessary facilities to the students.

Jalozai Campus

The Jalozai Campus funded by HEC at the cost of Rs. 6,565.272 Million is established on Pabbi-Cherat Road at 11 KM Southwards from GT Road in district Nowshera. At present there are five engineering and non-engineering departments which are offering undergraduate degree programs including civil engineering, electrical engineering, mechanical engineering, industrial engineering and Computer Science & Information Technology (IT). Having the services of all Ph.D faculty Jalozai Campus will offer education in eight engineering disciplines.
The Department of Agricultural Engineering was established in 1961 and has the honor of producing the first batch of Agricultural Engineers in Pakistan. Since then it has produced thousands of undergraduate and postgraduate students. Many of these graduates have worked and still working on key positions in various governmental, semi-governmental, private and international organizations. The Department started its MSc Engineering program in 1990 with emphasis on Soil and Water Engineering. In 1994, another area of specialization was added with emphasis on Farm Machinery and Power Engineering. The Department also started PhD program in these two major areas of Agricultural Engineering in 2004. These postgraduate programs in Agricultural Engineering require completion of advanced course work and a research project by the students to become skilled in research methodology. Our students are expected to plan, conduct and analyze a comprehensive research project, and to report the findings in a thesis, a scholarly document of research conducted in accordance with accepted scientific methodology. They benefit from a diverse applied engineering curriculum and enjoy small class size and frequent one-to-one contact with the faculty.

Agricultural Engineering is the application of engineering knowledge and techniques to agriculture. The constantly expanding population of the world has required and will continue to demand an ever-increasing agricultural production of food and fibers through improved irrigation and drainage systems, farm mechanization, and management of soil and water resources. Agricultural Engineering has been one of the major contributors to the increased production that has been realized during the past century. It is oriented to the design and control of equipment and systems for the production, processing and transportation of food, feed, and fiber, as well as the effective use of natural resources. However, it is not limited to agriculture only but has a broad spectrum of other applications like animal husbandry, fisheries, poultry, dairy industry, food processing industry, and grain and cold storages. Renewable energy, bioenergy and biological engineering are a recent addition to this list. In all of these fields the major portion of investment is engineering in nature. This warrants the recruitment of only qualified agricultural engineers to appropriate positions in these fields as agricultural engineering is the only discipline that integrates relevant knowledge of other inter-related disciplines of engineering and natural sciences into one discipline.

There are four faculties created to administered the performance of respective departments.

**Faculty of Electrical and Computer Engineering**
- Department of Electrical Engineering, Peshawar
- Department of Electrical Engineering, Bannu Campus
- Department of Electrical Engineering, Jaloza Campus
- Department of Electrical Engineering, Kohat Campus
- Department of Computer Systems Engineering, Peshawar Campus
- Department of Electronic Engineering, Abbottabad Campus
- Department of Computer Science & IT, Peshawar Campus
- Department of Computer Science & IT, Jaloza Campus

**Faculty of Mechanical, Chemical & Industrial Engineering**
- Department of Mechanical Engineering, Peshawar Campus
- Department of Mechanical Engineering, Jaloza Campus
- Department of Industrial Engineering, Peshawar Campus
- Department of Industrial Engineering, Jaloza Campus
- Department of Mechatronics Engineering, Peshawar Campus
- Department of Chemical Engineering, Peshawar Campus
- Center for Advanced Studies in Energy, Peshawar

**Faculty of Civil, Agricultural & Mining Engineering**
- Department of Civil Engineering, Peshawar Campus
- Department of Civil Engineering, Jaloza Campus
- Department of Civil Engineering, Bannu Campus
- Department of Mining Engineering, Peshawar Campus
- Department of Agricultural Engineering, Peshawar Campus
- National Institute of Urban Infrastructure Planning, Peshawar
- Gems & Jewelry Center of Excellence, Peshawar Campus
- Earthquake Engineering Center, Peshawar Campus

**Faculty of Architecture, Allied Sciences & Humanities**
- Department of Architecture, Abbottabad Campus
- Department of Basic Science & Islamiat, Peshawar Campus
Department of Agricultural Engineering

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CHAIRMAN
Prof. Dr. Zia-ul-Haq Ph.D. (UK)

PROFESSORS
Prof. Dr. Taj Ali Khan Ph.D. (UK)
Prof. Dr. Zia-ul-Haq Ph.D. (UK)

ASSOCIATE PROFESSORS
Dr. Muhammad Ajmal Ph.D. (S.Korea)
Dr. M. Shahzad Khan D.Engg. (Bangkok)

ASSISTANT PROFESSORS
Engr. Mahmood Alam Khan M.Sc. (Pak)
Dr. Abdul Malik Ph.D. (Pak)
Engr. Khurram Sheraz M.Sc. (Pak)

LECTURERS
Engr. M. Hamed Khan M.Sc. (Pak)
Engr. Sajjad Ahmad M.Sc. (Pak)
RESEARCH PROJECTS AND FACILITIES
Our qualified faculty is actively engaged in research projects/studies. Following faculty projects/studies have been conducted in collaboration with different national and international agencies.

- Development of Sugar Beet Planter for Small Farm holdings in Pakistan and Consumptive use study in Peshawar Valley.
- Revision of standards and specifications for Water Management at Farm level.
- Design and development of sugarcane planter for small and medium landholdings of Pakistan.
- Improving Efficiency of on-farm water use and application.
- Integrated Land and Water Management for Stressed Lands.
- To study the drinking water quality in selected areas of Peshawar.
- To determine the sources of ground water pollution in Peshawar.

AREAS OF SPECIALIZATION

Soil and Water Engineering
The Department is offering specialization in Soil and Water Engineering. Increasing problems with the scarcity and misuse of water supplies call for extensive research and extension efforts. Improved utilization and management technologies of all aspects of water use have to be actively researched. Emphasis is given to the design and evaluation of pressurized irrigation systems and various water harvesting techniques.

Farm Machinery and Power
Specialization in Farm machinery and Power is aimed to produce qualified technical manpower in the field of Agricultural Engineering. The role of Agricultural Machinery for the increase and timely production of crops cannot be ignored. Therefore it is important to acquire trained qualified agricultural engineers to handle agricultural machinery problems of modern age. This programme offers research based higher technical education to enable our graduates to apply necessary knowledge and skills to upgrade and modify the use of power and machinery according to the local field conditions of Khyber Pakhtunkhwa.

Interaction with Industry
The Department has a strong research linkages with the following organizations:-

- On Farm Water Management (OFWM)
- National Agricultural Research Council (NARC)
- National Drainage Programme (NDP) and International Water Management Institute (IWMI)
- Environmental Protection Agency (EPA)
- Farm Machinery Institute (FMI)
- Pakistan Council for Research in Water Resources (PCRWR)
- Agricultural Processing Industry, Livestock and Poultry Industry

The Department has conducted successful collaborative research programmes with national and international organizations such as PARC/NARC, UGC, EPA, USAID and GTZ.
LIST OF APPROVED COURSES

SOIL AND WATER ENGINEERING

AE 5410 SURFACE IRRIGATION (3)
The practice of irrigation; selecting an irrigation method. The irrigation requirements; types of surface systems; field measurement techniques; Evaluation of field System, Furrow, Border and Basin Irrigation Design; Land Leveling; Operation of surface irrigation systems; Headland facilities; Debris and sediment removal; Fundamentals of surface irrigation Hydraulics.

AE 5411 SPRINKLE AND TRICKLE IRRIGATION SYSTEM (3)
Sprinkle system components, sprinkle system design procedures; Hydraulics of Sprinkle system. Various types of agricultural sprinkle systems. Installation, Operation and Maintenance of Sprinkle Systems. Extend and advantages to Trickle irrigation; Trickle system components and design; Maintenance and operation requirements.

AE 5413 DESIGN OF CANAL STRUCTURES (3)
General requirements and design considerations. Design of conveyance structures. Regulating structures, Protective structures, Water measurement structures; and energy dissipaters. Transition and erosion protection; Pipe and pipe appurtenances, safety:

AE 5414 IRRIGATION PUMPING PLANTS (3)
Hydraulic Fundamentals, Friction of Water, properties of water, Centrifugal pumps performance; NPSH for pumps and pumping liquids.

AE 5415 APPLIED WATERSHED HYDROLOGY (3)

AE 5416 SOIL AND WATER POLLUTION (3)
Types of pollution, point and non-point pollution, sources of pollutants, solid waste management. Water quality analysis and standards. EPA objectives and EIA. Transport phenomena, advection and dispersion, pollution of surface and groundwater, salt-water intrusion. Agricultural pollution, soil pollution, water logging and soil salinization, soil erosion and sedimentation.

AE 5420 SALINITY AND SOIL WATER MANAGEMENT (3)
Irrigation and salinity in perspective; Methods of salinity related analysis and units; Properties and chemistry of salts. Origin of salt ions and accommodation of salts in water and soils; Effect of
salinity on plant growth. Reclamation and management of saline and sodic soils; Evaluation of water quality for irrigation.

AE 5421 SOIL AND WATER CONSERVATION (3)

AE 5422 ADVANCED SOIL PHYSICS (3)

AE 5430 GROUND WATER HYDROLOGY (3)
Groundwater and aquifers; Physical properties of aquifers and vadose zones; Darcy's Law and Hydraulic conductivity; well flow systems; Measurement of Hydraulic conductivity; Transmissivity; Specific yield and Storage Coefficient Ground water exploration; Well construction and pumping; Flow system analysis, Models and unsaturated flow, Surface water relations; Ground water quality and contaminations.

AE 5432 FLOW THROUGH POROUS MEDIA (3)
Properties of porous media and fluid mixtures; Heterogeneous fluids in static systems; Equations of fluid flow in Porous media. Steady flow in Heterogeneous fluid systems, unsteady flow of Heterogeneous fluids. Similitude for flow of two fluids.

AE 5441 SUB-SURFACE DRAINAGE (3)
Drainage investigations; Hydraulic conductivity determination; Design procedure for the interceptor drains, open drains, pipe drains, spacing of drains; Investigation and layout for drains; Operations and maintenance of drainage system; Special drainage problems.

AE 5490 SPECIAL STUDIES (UPTO 3 CREDITS)
Individual studies on selected topics.

AE 5491 TECHNICAL REPORT WRITING AND RESEARCH METHODOLOGY (3)
Basics of technical writing process, Technical writing techniques and applications, Definition and basics of research, Research purpose, Design of research methods, Identification of research problem, Literature review, Selection of data collection techniques, Selection of representative sample, Writing of research proposals, Data collection and analysis techniques, Limitations and significance of research techniques, Quantitative and qualitative research procedures, Writing of research reports, Presentation skills, and oral presentations.

AE 5499 Master's THESIS (6)
AE 6499 Ph.D. THESIS (1-9)

FARM MACHINERY AND POWER
AE 5450 TRACTION DYNAMICS (3)
Traction theory, Mechanics of wheels and stability dynamic forces, tracks and vehicles pressure
distribution in soil, rolling resistance, tractive efficiency and economics of vehicle operating on soil, hard surfaces and roads, technical study of design and performance of agricultural tractors.

**AE 5451 ADVANCED AGRICULTURAL MACHINERY DESIGN (3)**
Definition Analysis and Solution of a design problem in Agricultural Engineering. Design of machine elements, the use of theory of failures, fatigue, stress concentration, shock and impact analysis in the design of machine members, design of cylindrical mold board, design of discs, jointers, subsoilers and coulters. Laboratory work will include an in-depth study of the testing and analysis of machine components.

**AE 5452 KINEMATICS AND DYNAMICS OF MACHINERY (3)**
Introduction to numerical methods, the first and second differences, adjustment calculus. Role of Kinematics, determination of acceleration and velocities, analysis of slider crank mechanism application of method and special role of four-bar linkage. Introduction to dynamics, D'Alembert Principle equation of motion for machine with one degree of freedom. Balancing of rigid machines and linkages, principle of vibro-isolation. Eigen Value problem, vibration analysis by computer, computer simulation of high speed and cam mechanisms.

**AE 5453 INSTRUMENTATION AND CONTROLS IN AGRICULTURAL ENGINEERING (3)**
Theory of basic electronics and standard measurements. Theory of basic instrumentation, transducers and microprocessor or interfacing and application Agricultural Engineering problems.

**AE 5454 HARVESTING MACHINERY (3)**
Introduction: Mechanism of separation, cutting-threshing and traction mechanism, loss of grain, settings for various crops, regulation for movement of combines and maintenance. Threshing History, methods of threshing (tangential axial, radial, combined). Power requirements for threshing, factors affecting grain damage and threshing methods of evaluating grain damage, new approaches and concepts in grain threshing. Shelling, Historical development of shelling, concave studies, forces acting on the concave, ear orientation studies damage evaluation, time of relaxation. Combine header History characteristics, header component analysis and evaluation. Cutterbars, Fundamentals of cutting, cutting forces, influences of cutter bar speed on header losses, impact cutting. Conveyors; Critical speeds of conveyors, grain damage, Harvesting machines for wheat and rice.

**AE 5455 TRACTOR AND MACHINERY TESTING AND EVALUATION (3)**
A study of the principles and procedures used in conducting the Nebraska Tractor Test. Actual PTO drawbar, sound level and hydraulic lift test will be run. Importance testing of Agricultural Machinery, procedure for Farm Machinery
Testing and simulating the performance on computer. An additional special project may be elected for additional credit.

**AE 5456 THEORY OF MODELS-I (3)**

Dimensional analysis: Basics of dimensional analysis, application of dimensional analysis, classification of equations, conversion of equations, form of dimensional equations, determination of exponents by dimensional analysis. Development of predication equation; Basic procedures the Buckingghhan Pi theorem, determination of Pi terms, determination of functions, conditions for function to be a product, conditions for function to be a sum.

Models: Purpose of models, definition of a model, theory of models, types of models, scales, classes of pertinent quantities. Structural Model: True structural models forces, dynamic loading and vibrate fabrication, distorted structural models, predication factor. Soil Models: Selection of variables, true and distorted models.

1. Tillage tools models.
2. Tractor equipment models.

**AE 5457 THEORY OF MODELS-II (3)**

Fluid flow Model: Pipes and closed conduits, models of pipe lines carrying gas, cavitation in pipe lines, models of pipe channels, weirs, orifices, aerodynamic forces, models of ships. Reynold's Number, Froud Number, Webber Number, Cauchy Number, and Mach Number. Models of Rivers: General considerations, design conditions, materials and construction, erosion and sedimentation, distorted models. Thermal Models: Thermal properties, volume change in gas heat transfer, analysis with four dimensions, scales, Prendl Number, Jusselt Number. Electrical and Magnetic Models: Electrical Characteristics, basic DC Circuit basic AC Circuit, network analyzers, magnetic characteristics bass magnetic circuit problem, electromagnetic models, Introduction to dissimilar models.

**AE 5458 COMPUTER-AIDED-DESIGN (3)**

Use of Engineering Software such as Lotus 123, Freelance Graphics, AutoCAD, Application of Graphics in Design, Computer representation of Farm Machinery parts and Assemblies.

**AE 5459 SPECIAL PROBLEMS IN AGRICULTURAL ENGINEERING (3)**

A special problem in Agricultural Engineering will be selected by the student in consultation with his major professor. A careful study of the problem will be made and a report will be submitted by the student.

**AE 5460 SEMINAR**

Each Master student in Agricultural Engineering will give seminar of at least 2 credit during his program of studies. During a semester the seminar course of one credit can be offered jointly by the departments of Farm Machinery and Power and Soil and Water.

**AE 5499 MASTER'S THESIS (6)**

**AE 6499 Ph.D. THESIS (1-9)**
Department of Civil Engineering

Civil engineers plan, design, supervise the construction of and maintain many of the facilities and systems that are essential to modern life in both the public and private sectors. The civil engineering profession is one of the most stable and most diverse of the engineering disciplines. Civil engineers today are designing methods and facilities to cope with many of our planet’s most serious problems. In the face of foul air; decaying cities; roadways, and bridges; clogged airports and highways; polluted streams, rivers and lakes, the civil engineer is being called on to design solutions that are workable and cost-effective.

Civil Engineering Department (CED) was established in 1953-54. CED was the first one to introduce postgraduate studies with specialization in Water Resources and Structural Engineering in 1984-85. CED has the honor to be the first among all departments to start the Ph.D. programme in 2000. The ever-evolving PG (Post Graduate) programme of CED aims towards inculcating leadership skills, a strong sense of professionalism and ethical responsibility in the students and prepares them to recognize the need to engage in life long learning.

The students can select a programme that enhances their ability to work as professional engineers in a local/global economy by pursuing a Master’s of Science degree with a thesis that represents independent work, or Master’s degree with course work focuses on training of Civil Engineering practice in design and construction. Ph.D. programme requires training through course work, research and participation in seminars, conferences, workshops etc. Thus, original contribution to knowledge through Ph.D. research ensures a career in research academia or consultancy.
Civil Engineering

RESEARCH PROJECTS AND FACILITIES
In order to facilitate the Postgraduate study CED fulfills all the necessary infrastructural requirements like Research & Development (R&D) and Post Graduate computing center, Postgraduate Library, laboratory facilities such as 16m tilting flume, 200 Tons straining frame, 200 Tons computer controlled U.T.M. and a large test frame with latest data acquisition system and computer controlled tri-axial compression machine, etc., have been installed. Recently, an Earthquake Engineering Center has been established at CED with the objective of seismic disaster mitigation in the country.
CED helps students to gain practical understanding of the concepts and facilitates Postgraduate research work through its various state-of-the-art laboratories such as Concrete Laboratory, Soil Mechanics & Highway Engineering Laboratory, Structural Laboratory, Hydraulics Laboratory, Material Testing Laboratory, Surveying Laboratory and Public Health Laboratory.
The department offers consultancy services, technical assistance, and laboratory facilities to various government, semi-government and private agencies. The laboratories that are used for these commercial testing include Soil Mechanics and Highway Laboratory, Material Testing Laboratory, Concrete Laboratory and Public Health Laboratory. CED extends its advisory and consultancy services for the diversified nature of Civil engineering problems/design faced by commercial sector (e.g. Non-Destructive Testing, Structural Design, Rehabilitation of existing structures etc). Other civil engineering institutions of the country seek help of CED that has improved upon its intellectual and physical resources over a long period of time. The provincial department often hires the design, vetting and forensic services of our department in connection to various infrastructural projects.

AREAS OF SPECIALIZATION
The objective of the specialization programme is to provide quality education that is well balanced in theoretical and practical considerations and to prepare quality human resource keeping in view the national needs and thus aspiring towards making the country self-sufficient in the various fields of study. The postgraduate research programme also requires the students to attend seminars, conferences, symposia and publish papers in the journals of national and international repute. Upon the culmination of the postgraduate degree, graduates of the Postgraduate programme will become contributing engineering professionals and influential leaders in the field. In response to national needs, the Department of Civil Engineering offers Master and Ph.D. degrees in Civil Engineering in the following areas of specialization:
1. Environmental Engineering
2. Water-Resource Engineering
3. Structural Engineering
4. Geotechnical Engineering
5. Transportation Engineering
6. Earthquake Engineering
In addition, the Department of Civil Engineering also offers Master’s degree program in Construction Project Management.
Civil Engineering

LIST OF APPROVED COURSES

STRUCTURAL ENGINEERING

CE 5110 ADVANCED STRUCTURAL ANALYSIS-I (3)

CE 5111 ADVANCED STRUCTURAL ANALYSIS-II (3)
Application of stiffness and flexibility methods to trusses, frames and arches. Analysis of space frames. Development of computer programme based on stiffness methods. Use of commercially available computer programmes for structural analysis.

CE 5112 ADVANCED MECHANICS OF MATERIALS (3)

CE 5114 BEHAVIOUR OF CONCRETE STRUCTURES (3)
Analysis of reinforced and prestressed concrete section based on the mechanics of elastic and inelastic performance of steel and concrete and principles of equilibrium and compatibility. Behaviour of reinforced concrete and prestressed concrete members to failure under compression, tension, flexure, torsion and shear; Moment-curvature, Load-deflection. Torque-twist relations.

CE 5115 ADVANCE CONCRETE DESIGN (3)
(Pre-requisite CE 5110)
Design of Reinforce Concrete Structures for Gravity & lateral loads, various structural systems. Design of Flat Slabs (by DDM, EQM), Shear Wall, Shear Wall Frame Interaction, Design of various structural joints such as Beam Column joints etc. Yield line analysis of slabs, portion design.

CE 5152 PRE-STRESSED CONCRETE DESIGN (3)
Design consideration, pre-stressing Techniques, Materials, Analysis of Pre-stress members, Stresses at various stages of Pre-stressing, continuous Precast Pre-stressed structures, moment-curvature relationship, deflection, draped strands, losses in Pre-stress. Design project or term paper.

CE 5153 ADVANCE STEEL STRUCTURE-I (3)
Design Philosophies, Safety code and specification, behavior and design of Building system, members with axial load plus bending, Elastic frame Behavior and bracing system, Behavior and design of connection, Plate-girder Design, Design project or term paper.

CE 5154 INTRODUCTION TO BRIDGE ENGINEERING (3)
Bridge Elements, load (AASHTO code, code of practice in Pakistan), Analysis and Modeling
Civil Engineering

Technique, Simplified live load distribution procedure, influence lines and surfaces, Design of steel/Pre-stress bridges, sub-structure design, Design Project or term paper.

CE 5155 FINITE ELEMENT ANALYSIS OF STRUCTURAL SYSTEMS (3)

CE 5156 PLATE AND SHELL STRUCTURES (3)
(Pre-requisite CE 5155)
Analysis of plate and shell structures with particular emphasis on Civil Engineering applications and shells. Analysis of plates by finite differences, Membrane solution of shells of revolution, cylinders, elliptic, and hyperbolic paraboloids. Asymptotic solution for symmetrically loaded shells of revolution, Folded plates.

CE 5192 ADVANCE CONCERT TECHNOLOGY
Course Outlines
Evolution of concert, Compositions of concert, Required properties of concrete, Theory a aggregate assembly, consistency and pumpability of fresh concrete, Plasticizers and super plasticizers, Hydration & hardening process of concrete, Hardened structure of hydrated cement gel, Heat and thermal stresses, concerting in sever conditions, durability design of concrete structures, moisture transport in concrete, Alkali aggregate reactivity, Delay ettringite formation, Autogeneous and drying shrinkage, corrosion of reinforcement, Additives and admixtures, Advances in concrete technology, High performance concrete, Autoclaved cellular concrete, Concrete mix design, Environmental concerns related with cement and concrete

Recommended Books
1. Concrete Technology theory & practice by M.S Shetty
2. Properties of Concrete by A.M Nevelle.

Reference Books
1. Advance Concrete Technology Constituents Materials by John Newman, Bang Seng Choo
2. Advance Concrete Technology Concrete Properties by John Newman, Bang Seng Choo

CE 5190 SPECIAL TOPICS (UPTO 3 CREDIT HOURS)
CE 5199 MASTER'S THESIS (6)
CE 6199 Ph.D. THESIS (1-9)

WATER RESOURCE ENGINEERING

CE 5120 FLUID MECHANICS (3)
The Navier-stokes and energy equations and their exact solutions, theory of laminar boundary
layers, stability and transition of turbulent flow, equations of mass, momentum and conservation of turbulent flow: turbulent boundary layers, wakes and jet diffusion.

CE 5121  OPEN CHANNEL FLOW (3)
Uniform flow in open channels, hydraulic jump surges, non-uniform flow subcritical and supercritical flow around bends or through transition. Unsteady flow in canals and rivers. Model analysis.

CE 5122  SEDIMENT TRANSPORT (3)
Frequency distribution of sediment particles setting velocities Transportation and deposition. Bed load functions, Movement and distribution of suspended load, Empirical formulae, Bed roughness in alluvial channels, Meanders, Sedimentation in reservoirs.

CE 5123  HYDRAULIC STRUCTURES (4)
Design of gravity dams, spill-ways, stilling basins, power intakes, transition and control structures, canal falls, the use of models in hydraulic design.

CE 5124  DAM ENGINEERING (4)
General features of earth and rockfill dams, types of embankments earth pressure and stability analysis; settlement studies; soil and rock investigations; earth dam design and construction; rockfill dam construction; construction testing; performance measurements, earth quake allowance.

CE 5125  SURFACE WATER HYDROLOGY (3)

CE 5126  WATER RESOURCES ENGINEERING & PLANNING (3)
Water resources investigations, comparison of alternatives, screening and formulation of projects, economic analysis of single and multipurpose projects. Probability concepts in planning. Mathematical models systems analysis.

CE 5127  RIVER MECHANICS (3)

CE 5128  WATER RESOURCES ENGINEERING (3)
Aquifers, Superposition of Elementary Solutions in Groundwater flow, Pumping Near Hydrogeologic
Environmental Pollution Control


Recommended Books


2. "Association for Project Management Body of Knowledge", The Association for Project Management Thornton House, 150 West High Wycombe Road, High Wycombe, Buckinghamshire,

Construction Project Management

Recommended Books

1. Smith, N.J, Engineering Project Management,
An introduction to the library and other information resources including the internet; an introduction to qualitative and quantitative research methods (including computer aided data analysis techniques); presentation skills including verbal, written and IT-based methods; time management strategies; writing a thesis, academic papers and research summaries, and innovative approaches to research.

Recommended Books


**CE 5117 ENGINEERING CONTRACTS AND TENDERING PROCESS (3)**

Engineering Contracts


Procurement Process

The Procurement Cycle, Procurement Procedure, Type of Procurement, Competitive-Bid Contracts, Surety Bonds, Pre-qualification of contractors, specification writing (General and Technical Provision), Assembling the specification.

**Recommended Reading/References**


**CE 5190 SPECIAL TOPICS (UPTO 3 CREDIT HOURS)**

**CE 5199 MASTER'S THESIS (6)**

**TRANSPORTATION ENGINEERING**

**CE 5180 ADVANCED PAVEMENT DESIGN (3)**


**CE 5181 PAVEMENT MANAGEMENT AND REHABILITATION (3)**
Civil Engineering

Pavement Evaluation and Performance: General
Concept of Pavement Evaluation, Evaluation of
Overview of transport project impacts. Trip and parking generation. Site traffic impact analysis.
Assessment of environmental impacts of transport facilities: noise, pollutant emission, visual impact. Measures to mitigate traffic impacts. Road safety study: accident characteristics, analysis techniques, remedial and prevention measures.

**CE 5189 GEOTECHNICAL ASPECTS OF HIGHWAY (3)**

Site investigation for highways, soil classification, Rock classification,


**CE 5190 SPECIAL TOPICS (UPTO 3 CREDIT HOURS)**

**CE 5199 MASTER'S THESIS (6)**

**CE 6199 Ph.D. THESIS (1-9)**

**GEOTECHNICAL ENGINEERING**

**CE 5130 ADVANCED SOIL MECHANICS-I (3)**

Fundamental concepts stress distribution in continuous media, Elastics displacements, Compressibility and Consolidation, Settlements.

**CE 5131 ADVANCED SOIL MECHANICS-II (3)**

Review of Shear strength concepts, Stress path, Critical state concept, Limiting equilibrium, Lateral earth pressure, Retaining structures, slope stability.

**CE 5132 HYDRAULICS OF GROUND WATER (3)**

Principles of Ground water hydraulics, Theory of flow through idealized porous media, the flow net solution, seepage, well problems.

**CE 5133 FOUNDATION ENGINEERING (3)**

Sub-soil Investigation, Excavations, Design of sheeting and bracing system, control of water, footing grillage, pile foundation cassion and cofferdam, methods of construction.

**CE 5134 ENGINEERING PROPERTIES OF SOIL-I (3)**

Study of soil properties that are significant in Earth Work Engineering including properties of soil solids, basic physiochemical concepts, classification and stabilization, laboratory work includes classification, permeability and compaction tests.

**CE 5135 ENGINEERING PROPERTIES OF SOIL-II (3)**

Continuation of engineering properties of Soil-I, including the study of compressibility, stress-stain relationship and shear strength theories for soils. Laboratory work include consolidation and shear strength tests.

**CE 5136 DYNAMICS OF SOIL FOUNDATION (3)**

Application of vibration and wave propagation theories to soil media, review of existing experimental data and empirical procedure for analysis of foundation vibration, prediction of soil
Civil Engineering

responses to impulse load, dynamic properties of soil and methods for their determination,
of soil-structure interaction effects. Practical considerations in design and construction practice.

Recommended Books
1. Fundamentals of soil dynamics by B. M Dass, Elsevier science
3. A Short course in Soil-structures Engineering of Deep Foundations, Excavations and Tunnels by Charles W.W. Ng

CE 5162  EXPERIMENTAL MECHANICS OF STRUCTURES (4)

Recommended Book
Structural modeling & Experimental techniques, by Haris & Sabins CRC publishers, 2nd edition

CE 5163  COMPUTER APPLICATIONS TO STRUCTURAL

ENGINEERING (3)
Theoretical basis of practical computer-oriented structural analysis methods. Design of earthquake resistant buildings and engineering structures using state-of-the-art finite element based software. Case studies and projects

Recommended Books
1. Progra3ming the Dynamic Analysis of Structures by P. Phatt, Span press
2. Finite Element Procedures by Klaus-Jurgen Bathe
3. Applied finite element analysis for engineers by Frank Stasa, Oxford University press, USA

CE 5164  SEISMIC RISK REDUCTION (4)
Fundamentals of seismic hazard analysis: seismic parameters for vulnerability and risk analysis. Earthquake damage and usability classification: inventory of elements at risk; damage and usability classification of buildings, transportation systems and lifelines, facilities with essential emergency functions, facilities with a potential for large loss. Development of vulnerability functions: empirical, experimental and analytical vulnerability functions in buildings and structures: damage potential and vulnerability of transportation systems and
lifelines.

Vulnerability of non-aseismic and aseismic lifelines.
et al

CE 5170  **SEISMIC DESIGN OF LIFE-LINE STRUCTURES (3)**
Life-line systems - definitions and classification; behavior and damage in past earthquakes; engineering practice and research; methodologies of life-line earthquake engineering; life-line vulnerability and seismic risk; fundamental concepts of seismic design codes, overview of existing design codes; post-earthquake serviceability and functional restoration; seismic damage rehabilitation, retrofitting and economic evaluations.

Recommended Books
1. Seismic Design Handbook by Farzad Naiem
2. Earthquake Engineering handbook by W.F. Chen, CRC publishers

CE 5171  **REPAIR AND STRENGTHENING OF STRUCTURES (4)**
Introduction: typical failure modes of particular civil engineering structures, damage inspection, data collection and evaluation, emergency and post-earthquake reconstruction programme. Repair and strengthening design procedure: Criteria for repair and/or strengthening of structures, selection of repair and/or strengthening method. Repair and/or strengthening of structural components and upgrading of integral structural systems
of bridges, industrial halls, complex buildings, etc.
Applicable analysis methods and structural methods for seismic safety evaluation of repaired structures, design improvement and detailing.

Recommended Books
1. Masonry Design and Construction, Problems and Repair by Melander/Lauersdort
3. Earthquake-Resistant Design of Masonry Building by Miha Tomazevic
4. Seismic design & retrofitting of bridges by Priestly, Sabble, Willey publishers

CE 5190  **SPECIAL TOPICS (UPTO 3 CREDIT HOURS)**
CE 5199  **MASTER’S THESIS (6)**
CE 6199  **Ph.D. THESIS (1-9)**
The Department of Electrical Engineering was established in 1952 as part of Faculty of Engineering, currently offering undergraduate and postgraduate academic programmes in electrical engineering (communications) and electrical engineering (power).

Academic programme at postgraduate level is designed to prepare students to get a thorough knowledge of basic principles in high performance communication systems the work focuses on the provision of secure mixed media communications systems in a variety of mobile environments.

The challenging problems facing the electrical power industry today are much greater than before. System design trends have been towards higher power rating and higher operating voltages. Planning and designing of modern power systems call for an increasing number of specialized engineers. These requirements cannot be met by undergraduate courses because of the very wide range of studies undertaken at this level. Specialization in electrical power engineering is therefore essential in order to prepare the engineers to face these challenges. It is only at the graduate level that an engineer will attain competency to relate the theoretical knowledge to a specific problem in planning, designing and operation of a modern electrical power system.

The Department has adequate competent facilities which are available at both educational and professional levels. The programme of postgraduate education in electrical engineering has been designed to include course work in the major subjects of electrical power engineering and communication engineering with a research thesis to be done independently by each student. Emphasis will be given on imparting in-depth knowledge and developing research capabilities among the students.

CHAIRMAN
Prof. Dr. Syed Waqar Shah Ph.D. (UK)

PROFESSORS
Prof. Dr. Syed Waqar Shah Ph.D. (UK)
Prof. Dr. M. Naeem Arbab Ph.D. (UK)
Prof. Dr. Amjadullah Khattak Ph.D. (Pak)
Prof. Dr. K.M. Yahya Ph.D. (USA)
Prof. Dr. M. Inayatullah Khan Babar Ph.D. (USA)
Prof. Dr. Haseeb Zafar Ph.D. (UK)

ASSOCIATE PROFESSOR
Dr. Tariqullah Jan Ph.D. (UK)

ASSISTANT PROFESSORS
Dr. Gulzar Ahmad Ph.D. (Pak)
Dr. Gul Muhammad Khan Ph.D. (UK)
Dr. Shahid Bashir Ph.D. (UK)
Dr. Naeem Ahmad Jan Ph.D. (UK)
Engr. S.M. Majid Ashraf M.Sc. (Denmark)
Engr. M. Iftikhar Khan M.Sc. (Pak)
Engr. Siddique Ali M.Sc. (Pak)

LECTURERS
Engr. Muhammad Amir M.Phil (UK)
Engr. Asiya Jahangir M.Sc. (Pak)
Engr. Seema Mir Akbar M.Sc. (Pak)
Engr. Faheem Ali M.Sc. (Pak)
Engr. Salman Ilahi M.Sc. (Pak)
Engr. Uzma Nawaz M.Sc. (Pak)
Engr. Bilal-ur-Rehman M.Sc. (Pak)
Engr. Hina Zahir M.Sc. (Pak)
Engr. M. Usman Ali M.Sc. (Pak)
Engr. S.M. Faheem M.Sc. (Sweden)
Engr. M. Kashif Khan M.Sc. (Pak)
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**RESEARCH PROJECTS AND FACILITIES**

The department is actively participating in research activities at both Master's and Ph.D. level. The research projects are scrutinized for their application towards problem solving in industry.

**INTERACTION WITH INDUSTRY**

The Department presently has industrial links mainly with power and communication related companies and organizations like WAPDA and PTCL. A team of well-organized experts in the field of electric power, electronics and telecommunications holds regular meetings with these organizations through departmental steering committee and seminars. A number of research projects, especially at Ph.D. level are presently underway, pertaining to problems faced by the industry. The endowment fund programme by the Government of Pakistan provides financial assistance for the research projects.
LIST OF APPROVED COURSES

ELECTRICAL POWER ENGINEERING

EEP 5201 POWER SYSTEM ANALYSIS-I (3)
Circuit concepts, power system representation, transmission lines, the power transformer, the synchronous machine.

EEP 5202 POWER SYSTEM ANALYSIS-II (3)
The power flow problem, balance and unbalance faults, fault analysis by computer methods, power system stability.

EEP 5203 POWER SYSTEM PROTECTION (3)
Detection of system variables, relays, fuses and circuit breakers, protection of power transformer, motor, generator and lines, voltage and current transformers.

EEP 5204 POWER ELECTRONICS (3)
Thyristers operation and characteristics, Thyristor controlled circuits, Thyristor controlled motors, introduction to power semi-conductor devices and their application in generation and control of electrical energy.
A study of analogue and digital process control including signal conditioning, transducers, actuators and control element.

EEP 5205 HIGH VOLTAGE D.C. TRANSMISSION (3)
Economics of transmission. Converter operation and design, controls and protection, harmonics and filters.

EEP 5206 HIGH VOLTAGE TRANSMISSION SYSTEM (3)
High voltage transmission systems, electrical characteristics, corona on a.c. lines, Radio and Television Interference, Audible noise, corona loss, Insulation design, Electrostatic effects.

EEP 5207 ELECTRICAL TRANSIENTS IN POWER SYSTEM (3)
Transient performance of power systems, circuit interruption, switching transients, traveling waves, behavior of windings under transient conditions, protection against transient over voltage, Insulation coordination.

EEP 5208 OPERATION OF POWER SYSTEM (3)
Operation objectives, load forecasting, Dispatch of real and reactive power, Characteristics and economic operation of steam and Hydro plants, Transmission loss formula, incremental production costs and incremental transmission losses for optimum economy, generation scheduling, environmental constraints.

EEP 5209 FIELD THEORY (3)
Introduction to basic analogies in field systems, calculation of simple field, two dimensional analytic solutions, mapping, Schwartz-Christoffel transformation, Relaxation methods, field plotting method, three dimensions fields.

Electrical Engineering
EEP 5210 DIRECT ENERGY CONVERSION (3)
Introduction to specialized electric energy sources e.g. photovoltaic. Thermionic converters, Magnetohydrodynamics generation, fuel cell, wind-electric system. Solar Thermal system. Coordination of alternate energy plants.

EEP 5211 POWER SYSTEM RELIABILITY (3)
Concept of P.S. reliability, reliability indices, component reliability, evaluation of generating capacity, reliability evaluation of transmission and distribution system, evaluation of composite generation/transmission system failures modes. Parallel and series systems.

EEP 5212 POWER SYSTEM CONTROL (3)
General characteristic of system control, computer and microprocessor applications., Telemetry channel, Data acquisition and logging, Man/Machine interface, Automatic generator control voltage and reactive control optimum dispatch. Power station controllers.

EEP 5213 MATERIALS SCIENCE (3)
Physical, electrical and optical properties of metals, semiconductor, dielectric and magnetic materials and their application in power equipment, Super conductivity.

EEP 5214 POWER SYSTEM PLANNING (3)
An introduction to planning procedures for large electrical system, technical and economical constraints in planning.

EEP 5216 ADVANCED ELECTRONIC CIRCUITS (3)
Specifications and applications of available IC's OPAMPS, phase Lock Loops, AID, DIA converters etc. Communications on power lines.

EEP 5217 DIGITAL SYSTEMS (3)
Introduction to computer hardware and architectures: Principles of Micro processor based system designs.

EEP 5224 POWER ELECTRONICS: CONVERTER MODELING, ANALYSIS AND DESIGN (3)
Principles of electronic power conversion in switched-mode converters. Analysis and design of PWM (Pulse-Width-Modulated) converters including the selection of components, design of magnetic components, design of feedback loop, measurement of performance, and fundamentals of circuit layout and EMI (ElectroMagnetic Interference).

Recommended Book

EEP 5228 ELECTRICAL INSULATION ENGINEERING (3)
INTRODUCTION
Physical properties of insulating materials, Electrical and Mechanical strength parameters, Ionization and dissociation processes, charge transport...
mechanism, recombination and ion formation, Thermal processes.

Dielectric Properties:

Polarization and dielectric relaxation, dielectric constant, an-isotropic and homogeneous dielectrics, Dielectric breakdown, Dielectric behavior in high electric and magnetic fields, Displacement currents. Dielectric types and their characteristics, Classification of insulation in terms of their dielectric properties.

Insulation Failure

Townsend and Streamer theories, Electromechanical and thermal instability, Discharges in insulation defects, Effects of impurities on insulation behavior, Avalanches and secondary streamers. Time lags and TOV. Arc and plasma formation.

Insulation under polluted conditions: Behavior of overhead line insulation under pollution, scintillation and dry band formation, surface energy and contamination measurement (ESDD).

Insulation Design

Material properties, Capacitance and sheath grading, Composite design, Determination of voltage and electric field distribution, Calculation of CFI and BIL. Insulation design for Transformers, Rotating Machinery and Underground cables, Insulation design for overhead transmission lines.

Insulation Testing

Impulse testing of insulation, Insulation testing under lightning and switching surges, Tests with chopped waves, Insulation testing under HVAC and HVDC conditions, Wet and dry tests, Voltage withstand tests, Fog chambers, Schering bridge, Determination of loss tangent for various types of insulation. High frequency electric field testing of insulation.

Special Purpose Insulation: Insulation for cables in nuclear environment, cryogenic temperatures, Insulation for super-conducting magnet coils, Insulation for cables used in spacecrafts.

Recommended Books

1. Insulators for High Voltage, J. S. T. Looms.
2. Electrical Insulation, Edited by Bradwell, IEE Monogram Series.

EEP 5238 ADVANCED POWER ELECTRONICS (3)

Averaged switch modeling of switched-mode converters, input filter design, current-programmed control of converters, power and harmonics in non-sinusoidal systems, and line-commutated and pulse-width-modulated rectifiers.

Recommended Book

Recommended Books networked communication from local area networks up to the global Internet and shall study a range of problems. The course focuses on the TCP/IP protocol suite. The main headings covered during the semester are: Layered architectures (Internet and the OSI Reference Model), Overview of networking and communication software (Sockets), Standards in access protocols (CSMA, etc.), Architectures and control algorithms, Coding theory deals with the issues of local-area, point-to-point, and mobile networks, protection of data while passing through hostile environments. It deals with techniques that add enough redundancy in data to protect information bits without overloading the system. Every information transfer system today employs one form or another of channel coding technique. Wireless 802.11 Networks, Packet-Switched Networks, Switching and Forwarding, Bridges and Discrete Sources and Entropy, Channels and Internetworking, Internet Protocol (IP), Unicast and Multicast Routing, Global Internet, MPLS, End-to-End Protocols, UDP, TCP and RPC.

Recommended Book


EEP 5290 SPECIAL STUDIES (3)

INDIVIDUAL STUDIES ON SPECIAL TOPICS.
Recommended Books


**EEC 5280 INFORMATION AND CODING THEORY (3)**

Information theory also deals with source coding, channels and channel capacity, entropy, Shannon’s theorems etc. Coding theory deals with the issues of protection of data while passing through hostile environment. It deals with techniques that add enough redundancy in data to protect the information bits without overloading the system. Every information transfer system today employs one form or another of channel coding technique. To understand these concepts, the topics that will be covered are:

Discrete Sources and Entropy, Channels and Channel Capacity, Run-length Limited Codes, Linear Block Error-correcting Codes, Cyclic Codes, Convolutional Codes, Trellis Coded Modulation and Information Theory and Cryptography.

Recommended Book

Applied Coding and Information Theory for Engineers” by Richard B. Wells

**EEC 5281 COMPUTER NETWORKS (3)**

In this course, we shall explore the issues for networked communication from local area networks up to the global Internet and shall study a range of solutions to the associated problems. The course will focus on the TCP/IP protocol suite. The main heading covered during the semester are: Layered architectures (Internet and the OSI Reference Model), Overview of networking and communication software (Sockets), Standards in networks access protocols (CSMA, etc.), Architectures and control algorithms of local-area, point-to-point, and mobile networks, Models of network interconnection, Design issues and protocols in the data link, network, and transport layers, Direct Link Networks, Encoding and Framing, Error Detection and Reliable Transmission, Ethernet and Token Ring Networks, Wireless 802.11 Networks, Packet-Switched Networks, Switching and Forwarding, Bridges and LAN Switches, Cell Switching (ATM), Internetworking, Internet Protocol (IP), Unicast and Multicast Routing, Global Internet, MPLS, End-to-End Protocols, UDP, TCP and RPC.

Recommended Book


**EEC 5282 MOBILE NETWORKING (3)**

This course examines mobile data networks,
mobility issues in networking and covers fundamentals of mobile network architectures.
Academic Publisher, 1998

6. UCLA theses on high speed computational unit

**EEC 5296 DATABASE DESIGN & MANAGEMENT (3)**


**Recommended Book**

Modern Database Management, by Hoffer, Prescott and McFadden

**EEC 5284 TELECOM SWITCHING & SIGNALING SYSTEMS (3)**

The course presents the principles and history of the public switched telephone network and to describe the hardware and software architectures of several commercial telephone systems. It describes signaling and the Intelligent Network, and how they inter-operate to provide telephone service, it compares switching paradigms and the evolving infrastructure, and it discusses the future of telephony. The topics include; Introduction, Background, Line side, Trunk side, Traffic theory, Circuit Switching Technologies (Past, present and the future) Interconnection fabrics, Toll point, Enterprise switching, Signaling System 7, Programme control, Digital switching concepts & 4E, Sys75 & 5E hardware, Sys75 & 5E software, Bell System, Signaling, Software, Intelligent Network, Private networks, Switching paradigms, Evolving infrastructure, Future networks.

**Recommended Book**

Telephone Switching Systems, by Thompson

**EEC 5285 OPTICAL & HIGH SPEED NETWORKS (3)**

Optical beams and resonators including ray tracing, Gaussian beam propagation, stable and unstable resonators; classical theory of spontaneous and stimulated emission including a discussion of homogeneous and inhomogeneous line broadening; laser pumping and population inversion in three level and four level systems; fundamentals of laser oscillation, dynamics and threshold; laser cavity equations; laser spiking and mode competition; Q-switching; active and passive mode locking; injection locking; single frequency operation; introduction to fiber lasers and active optical fiber devices. Design Considerations of a Fiber Optics Communication Systems: Analog and Digital Modulator, Noise in Detection Process, BIT Error Rate (BER). System design, Maximum Transmission distance due to attenuation and dispersion.

**Recommended Books**

1. Optical Fiber Communications, by Cruiser, Gerdkiser
2. Opto-Electronic, by Wilson and Hawks
3. Laser Electronics, by Joseph T. Verneyen
EEC 5222 COMPUTER SYSTEM ARCHITECTURE AND ORGANIZATION (3)

Computer Organization review, Instruction Set Design principles and MIPS architecture, Pipelining (Basic pipelining, Data and control hazards, Exceptions, Branch Prediction), Instruction level Parallelism, Compilers and code optimization, Caches (Cache basics, Techniques to reduce miss rate, Techniques to reduce miss penalty), Programming for memory performance, Main memory organization, Virtual Memory and paging, Storage devices, Beyond ILP: Future microprocessor architectures

Recommended Books


EEC 5221 SWITCHING THEORY AND LOGIC DESIGN (3)

Information Representation, Binary number system and codes, Introduction to Boolean Algebra, Logic Gates and Special Functions, Logic reduction techniques

Logic reduction techniques continued, Don’t Cares, NAND and NOR implementations, Combinational Logic Design concepts, Design methodology, HDL introduction, Code Converters, Encoders/Decoders

Combinational Logic Building Blocks: multiplexers, demultiplexers, arithmetic circuits

Combinational Circuit Design, Delays, Transient Operation, Hazards

Sequential Logic Circuit Fundamentals, Flip Flops, characteristic tables

Sequential Circuit Analysis and Design Techniques and HDL representation

Sequential Logic Building Blocks, Registers and counters

Programmable Logic Devices; ROM, PAL, PLD and FPGAs

Design of Large Complex Circuits (e.g. Digital Computer), Separation of Data and Control path, Data path design, pipelined data path, the ALU

Control path design, State machine design

Computer Architecture concepts, Instruction Set Architectures

CPU designs; CISC and RISC
Computer Memory Organization; RAM, CACHE, Virtual Memory, Bulk Storage
**EEC 5267 DIGITAL CONTROL SYSTEMS (3)**


Recommended Book


**EEC 5286 OPTIMIZATION TECHNIQUES (3)**

Classical Optimization Techniques with equality constraints (e.g. Lagrange Multipliers etc) for 1 variable, two variables and many variables, Linear Programming, Integer Programming, Assignment problem, Transportation problem, PERT, CPM, Misc. topics in optimization techniques.

**EEC 5290 PROPAGATION FOR WIRELESS COMMUNICATION**


Recommended Books
1. Antennas and Propagation for Wireless communications By Simon R. Saunders
Department of Industrial Engineering

Industrial engineering addresses how systems operate and is concerned with the effective and efficient delivery of quality products and services. The tools applied include analytic modeling, system simulation, queuing systems, work design, project planning, facilities design and quality management and control.

Industrial engineers seek to allocate limited resources in an effective manner. A unifying theme focusing this body of knowledge and methods into a coherent entity is the systems point of view. Industrial engineering encompasses the search for similarity among concepts, laws and models of different disciplines; the emphasis on the adaptation, integration and exploitation of existing techniques in areas other than their fields of origin; and, above all, a unique point of view dealing with relationships rather than with components. Industrial engineers are thus in a strategic position to bring about the best integration of people, materials, machines, time and money in any endeavor.

These techniques are applied in a very wide range of organizations. There are industrial engineers in banks, hospitals, government, transportation and communications, construction, social service, facilities design, manufacturing, warehousing and information processing. Many industrial engineers move from analyzing and designing productive systems to managing those systems. While engineering and management are different fields, both require the ability to make decisions based on valid information. Industrial engineers are especially trained to obtain and evaluate such information.

The Department of Industrial Engineering was established in 2006. The Post Graduate programme started in Fall-2008, and is currently offering a Master’s degree in Manufacturing Systems Engineering which is one of the streams of Industrial Engineering. The Department has also started Ph.D. programme.
POST GRADUATE PROGRAMME
The graduate programme in Industrial Engineering (IE) offers both Doctor of Philosophy and Master of Science in Industrial Engineering with thesis option only. The programme is designed to accommodate the working engineers as well, by offering classes in the evening and on weekends. The curriculum for the thesis option is designed to give students greater breadth and depth of technical and practical IE knowledge. This option allows specialization in Industrial Systems Engineering, Manufacturing Systems Engineering, Operations Research, Quality Engineering, Industrial Management, and Human Factor Engineering areas. These are distinct areas, each tailored to specific IE career needs and characterized by both breadth and depth in its curriculum. Presently, the Department of Industrial Engineering offers master and Ph.D programme in the Manufacturing Systems Engineering and Master degree programme in Engineering Management.

Manufacturing Systems Engineering
Core area of specialization
1. IE 5710 Manufacturing Planning and Control
2. IE 5722 Engineering Experimental Design
3. IE 5726 Engineering Optimization
4. IE 5730 Maintenance & Safety Engineering
5. IE 5734 Quality Engineering
6. IE 5738 Computer Modelling and Simulations
7. IE 5750 Facility Analysis and Design
8. IE 5754 Design and Analysis of Manufacturing Systems
9. IE 5758 Advanced Manufacturing Processes
10. IE 5770 Mathematics
11. IE 5772 Technical Report Writing and Research Methodology

Optional Courses
1. IE 5701 Engineering Economics
2. IE 5702 Mathematical Statistics
3. IE 5703 Queuing Theory
4. IE 5704 Inferential Statistics
5. IE 5705 Finite Element Analysis
6. IE 5706 Organizational Systems
7. IE 5707 Dynamic Programming
8. IE 5708 Project Management Framework & Tool
9. IE 5709 Human Resource Management
10. IE 5711 Game Theory
11. IE 5712 Concurrent Engineering
12. IE 5713 Benchmarking
13. IE 5714 Operations Research
14. IE 5715 Network Analysis
15. IE 5716 Reliability Analysis
16. IE 5717 Tool Design
17. IE 5718 Scheduling
18. IE 5719 Replacement Models
19. IE 5720 Real Analysis
20. IE 5721 Ergonomics
21. IE 5723 Energy Management
22. IE 5724 Organizational Behavior
# List of Approved Courses

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<th>Course Title</th>
<th>Credits</th>
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<td>Supply Chain Management</td>
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<td>IE 5727</td>
<td>Business Process Re-engineering</td>
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<td>IE 5728</td>
<td>Management Information System</td>
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<tr>
<td>IE 5729</td>
<td>Combinatorial Optimization</td>
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<td>IE 5731</td>
<td>Quality Assurance</td>
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<tr>
<td>IE 5732</td>
<td>Statistical Quality Control</td>
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<tr>
<td>IE 5733</td>
<td>Project Management</td>
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<td>IE 5735</td>
<td>Stochastic Optimization</td>
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<td>IE 5737</td>
<td>Six Sigma Methodologies</td>
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<td>IE 5739</td>
<td>Cost &amp; Management Accounting</td>
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<td>IE 5740</td>
<td>Total Quality Management</td>
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<td>IE 5741</td>
<td>Project Evaluation &amp; Feasibility Analysis</td>
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<td>IE 5742</td>
<td>CAD/CAM</td>
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<td>IE 5743</td>
<td>Business Forecasting</td>
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<td>IE 5744</td>
<td>Operations Management</td>
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<td>IE 5745</td>
<td>Environmental Management &amp; Safety</td>
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<td>IE 5747</td>
<td>Marketing Management</td>
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<tr>
<td>IE 5762</td>
<td>Computer Integrated Manufacturing</td>
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<tr>
<td>IE 5766</td>
<td>Artificial Intelligence with applications</td>
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<td>IE 5780</td>
<td>Computer Applications</td>
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<td>IE 5784</td>
<td>Deterministic Optimization</td>
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<td>IE 5788</td>
<td>Stochastic Optimization</td>
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<tr>
<td>IE 5790</td>
<td>Special Topic</td>
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## IE 5701 Engineering Economics (3,0)

Cost concepts and design economics, cost estimation techniques, developing project cash flows, lease versus buy decisions, replacement analysis, dealing with uncertainty, impact of income tax and inflation on economic analysis, capital financing and allocation.

## IE 5702 Mathematical Statistics (3,0)

Probability spaces and random elements, Integration and differentiation, probability distributions and their characteristics, conditional expectations, asymptotic theory; Populations, samples, and models; statistics, sufficiency and completeness; statistical decision theory; statistical inference; asymptotic criteria and inference; Unbiased statistics, their variances, the Least squares estimates.

(LSE) in Linear models, the UMVUE and the BLUE, robustness of LSEs, Bayes decisions and estimators, invariance, maximum likelihood, the likelihood function and the MLEs, Uniform, Gamma, and Beta processes, Normal and the exponential family of processes, Sampling statistics, probability generating function, moment generating function.

## IE 5703 Queuing Theory (3,0)

Description and characteristics of queuing systems, Poisson process and exponential distribution, Markovian property, stochastic processes and Markov Chain.

Birth-death queuing models: Kendall notation, steady-
state solution for M/M/1 models, steady-state difference equation, M/M/c, and M/M/c/k models, Erlang formula, queuing with unlimited services, Network, Series and Cyclic queues, Models with general arrival and service patterns: Single server and multiple server queues with Poisson arrivals and general service, multi-channel queues with Poisson arrivals and constant service.

**IE 5704  Inferential Statistics  3 (3,0)**

Fundamentals of hypothesis testing: one-sample t-test, Two-sample t-tests, ANOVA and other tests with numerical data, Two-sample and c-sample tests with categorical data, multiple regression and response surfaces.

**IE 5705  Finite Element Analysis  3 (3,0)**


**IE 5706  Organizational Systems  3 (3,0)**

Integrating management systems, management, safety, managing indirect costs, controlling risks and cost, Management commitment and policy, responsibility and authority, objectives and targets, plan consideration, plan implementation, standard operating procedures, employees involvement, management and control of contactors and vendors, emergency preparedness and contingency planning, document control and record keeping processes, process risk analysis and assessment, measurement and evaluation, non-conformances and incident investigations.

**IE 5707  Dynamic Programming  3 (3,0)**


**IE 5708  Project Management Framework and Tools  3 (3,0)**

Define project, program and portfolio management, project structure, project life span, modelling project management, project management model in three decades, model with portfolio potential, logical progression, Marasco pyramid model, Project dynamics, project environment, project control, program and portfolio management, optimization portfolio
### IE 5706 Organizational Systems 3 (3,0)


### IE 5709 Human Resource Management 3 (3,0)


### IE 5710 Manufacturing Planning & Control 3 (3,0)

Deterministic inventory problems, Material requirement planning, manufacturing resource planning, Enterprise resource planning, Just-in-time manufacturing, Variability basics and their influence, Push-Pull and hybrid production systems and Supply chain management.

### IE 5711 Game Theory 3 (3,0)

Theory of rational choice, integration with intelligence and decision making, axioms, the expected utility maximization theorem, Bayesian conditional probability systems.

**Basic Models:** Games in extensive form, strategic forms and normal representation, Equivalence and reduced normal representation, elimination of dominated strategies.

Equilibria of strategic form games: Nash equilibrium theory, computation and significance of Nash equilibria, the Focal point effect, Purification of randomized strategies in equilibria, infinite strategies sets, The two person zero-sum game with equilibrium points, two-person non-zero sum game, Mixed strategies and behavioural strategies, Auctions, bargaining and cooperation in two-person games.

### IE 5712 Concurrent Engineering 3 (3,0)

Theory and philosophy of Concurrent Engineering, Planning the transition and Reducing organizational and cultural barriers, Product cycle time, Customer satisfaction, Reduction in engineering change orders or reworks, Strategies for selecting, staffing and managing multi-disciplinary functional project-teams. Principles of DFA/DFM for parts reduction and assembly, Learn design for X concepts (e.g., DFM, DFA, DFS, etc.) Pinpoint organization change and the effects of new engineering order, QFD, Taguchi method, Axiomatic design.

### IE 5713 Benchmarking 3 (3,0)

Strategic planning and the evolution of benchmarking, types of benchmarking, common criticisms of benchmarking; Steps in benchmarking, planning benchmark study- seven 'to-do' items, determination of activities to benchmark, identifying the benchmark team, scheduling the study and determination of key factors to measure, Identification of target organization (benchmark partner). Execution of the study: Data collection, data analysis. Implementing improvement, strategy assessment.

### IE 5714 Operations Research 3 (3,0)

How the simplex method works, Tableau and Dictionary methods, pitfalls (initialization, iteration and termination) in Simplex method and ways to avoid those, Speed of computation, How fast is Simplex method, The Duality theorem, Gaussian Elimination and matrices-number of steps, speed and accuracy issues, the LP
decomposition of matrices, the revised Simplex method, General LP problems and their solution by Simplex Method, Theorems on Duality, Feasibility and infeasibility of problems, Primal-dual relationship, sensitivity analysis, Efficient allocation of scarce resources, scheduling production and inventory, the cutting stock problem, matrix games.

IE 5715 Network Analysis   3 (3,0)
Formulation of network problems as linear programming problem, The transshipment problem, trees and feasible tree solutions, economic motivation for network Simplex method, degeneracy and cycling, termination and initialization issues, decomposition into sub problems, computer implementation, Inequality constraints, scheduling production and inventory, the Caterer problem, the Integrality theorem, doubly stochastic matrices, covers and matchings in bipartite graphs, chains and antichains in partially ordered sets, The assignment and transportation problems as network problems, Upper-bounded trans-shipment problems, Maximum flow through networks: The primal-dual method for network flows.

IE 5716 Reliability Analysis   3 (3,0)
Models and Uncertainties, Standards and Guidelines, Failure Models, Qualitative System Analysis, Systems of Independent Components, Component Importance, Dependent Failures, Counting Processes, Markov Processes, Reliability of Maintained Systems, Reliability of Safety Systems, Life Data Analysis, Accelerated Life Testing, Bayesian Reliability Analysis, Reliability Data Sources, use of Minitab or some other software.

IE 5717 Tool Design   3 (3,0)

IE 5718 Scheduling   3 (3,0)
Introduction to scheduling problem, performance measures of scheduling, single and multi-machines scheduling, parallel machines scheduling, flow shop scheduling, job shop scheduling, open shop scheduling and project scheduling.

IE 5719 Replacement Models   3 (3,0)
Introduction to replacement models, decision whether to repair or replace, modelling the decision, assumptions related to replacement decision, uncertainty in replacement acquisition costs, modelling and estimation of model parameters, modelling maintenance requirements and estimation of maintenance as well as life cycle costs.

IE 5720 Real Analysis   3 (3,0)
Topological properties of the real numbers, Completeness and least upper bound property. Cardinality of sets. Theory of metric spaces, Cauchy and convergent sequences, compactness, completeness, and connectedness, Continuous functions between metric spaces, Differentiability of functions of one variable, Differentiability of functions of several variables.

IE 5721 Ergonomics   3 (3,0)
Principles of ergonomics, Human characteristics
relevant to Ergonomics, the system approach and aspects of Ergonomics, role of human factors engineering in Artificial Intelligence, anthropometry, types of anthropometry, body dimensions of various organs, failure of design, anthropology and its types, climatic factors, sound and its measurements, effects of noise on various organs, principles of good lighting.

Basic cognitive capabilities and limitations of the workers, environmental situation and limitations conducting an ergonomic assessment, Developing an ergonomic program, Ergonomic issues related to posture, materials Handling/Lifting using the NIOSH, Frequent types of injuries related to workplace design, Repetitive motion, and cumulative trauma disorders, Preventing ergonomically related injuries by redesigning the workplace, Designing displays for Workers, Transfer and design of information, Controls and control arrangements.

**IE 5722 Engineering Experimental Design 3 (3,0)**

Sampling and descriptive statistics, Parameter estimation, Tests of hypothesis on the means, variance, and portions, testing of goodness of fit, Non-parametric tests, Experiments with single factor, Randomized blocks, latin squares and incomplete block designs, Regression analysis, Taguchi’s concepts and approach to parameter design, Response surface methodology.

**IE 5723 Energy Management 3 (3,0)**

Attitudes to energy efficiency, objective of energy management, priorities, and strategies. Plant control, control and use of an energy management system.

**IE 5724 Organizational Behaviour 3 (3,0)**


**IE 5725 Supply Chain Management 3 (3,0)**

The era of Physical Distribution Management, the Concept of Supply Chain, Channels Strategy and Alliances, the Changing Business Environment, Customer Focus in the Supply Chain, Achieving Customer Satisfaction Objectives, Transportation Choices in the Supply Chain, Inventory Management in the Supply Chain, Supply Chain Communications, International Supply Chain Management. Issues and Implications, Information for Supply Chain Management.

**IE 5726 Engineering Optimization 3 (3,0)**

Modelling techniques for selected case studies, and linear and nonlinear programming applications in engineering, duality and optimality conditions, Revised
primal and dual simplex methods, Sensitivity analysis, branch and bound methods, heuristic methods (Simulated annealing, Tabu search, Genetic algorithms, Artificial neural networks) and computerized real applications.

**IE 5727 Business Process Reengineering  3 (3,0)**

Fundamentals of process management; importance of process decisions and process choices; strategic process decisions for manufacturing and service environments. Costs, quality, and timeliness as the primary attributes of value; creation of value through strategies and processes.

Process improvement tools and frameworks; process maps, value stream mapping, service blueprinting, reengineering, Poka-Yoke, lean systems and sixsigma.

Simulation and modelling of discrete event systems and processes. Implementing BPR methodology, building the reengineering organization; identifying BPR opportunities, understanding existing processes, reengineering processes, blueprinting new business systems, performing transformation.

**IE 5728 Management Information System  3 (3,0)**


**IE 5729 Combinatorial Optimization  3 (3,0)**

Algorithmic and structural approaches in combinatorial optimization with a focus upon theory and applications. Topics include: polyhedral methods, network optimization, the ellipsoid method, graph algorithms, matroid theory and sub modular functions.

**IE 5730 Maintenance & Safety Engineering  3 (3,0)**

Planned and preventive maintenance, Predictive maintenance, Corrective maintenance, Advanced concepts (Reliability centred maintenance, Total productive Maintenance), Concepts of maintainability engineering, Design for maintainability, Availability, Decision models in maintenance management. National and international standards for preventing accidents in the workplace, recent developments in industrial systems’ safety and risk analysis techniques.

**IE 5731 Quality Assurance  3 (3,0)**

Basic elements of a quality assurance system, Quality standards such as ISO 9001 and ISO 17025, Structuring quality management system documentation: quality manual, quality plans, procedures, work instructions, records, QMS implementation and maintenance, Strategic and competitiveness issues in QMS, Computer-based information systems for QMS, Role of TQM and statistical methodologies in QMS, Quality auditing and management reviews, Continuous improvement through corrective and preventive action,
Familiarization with other standards such as ISO 14001, SA 8000, OHSAS 18000.

IE 5732 Statistical Quality Control 3 (3,0)
Review of Probability Theory, Effect of sample size on Control charts for variable (X-Bar and R or S) and attributes (p, np, c, u, CUSUM etc), determining the control limits and plotting the data; interpretation of charts, Gauge R & R analysis, identification of out-of-statistical control situations, trends and control mechanisms, Process capability and related indices, Type I and Type II errors, Single, double, multiple and sequential sampling, developing operating characteristic curves, acceptance Sampling: Sampling Plans, the ABC and Mil Standards.

IE 5737 Six Sigma Methodologies 3 (3,0)
Introduction to Six Sigma, Internal & External Customers, Define Measure Analyse Improve Control (DMAIC) Cycle, Six Sigma goals and Matrices, Six Sigma Training, Six Sigma Teams, Green, Black and Master Black Belt, Design for Six Sigma, Define Measure Analyse Design Verify (DMADV), Case Studies.

IE 5733 Project Management 3 (3,0)
Project Management and Project Control, Qualitative and Quantitative Risk Management, Project Management Structures Strategy, Portfolio and Program Management, Project cost estimation, Project procurement management, Managing Data and Configurations for effective project management, Managing Technology: Innovation, Learning and Maturity. Time, Cost and Critical Chain Management, Project Performance Measurement & Value Management, Improving quality in project and program, use of MS Project or Primavera.

IE 5738 Computer Modelling and Simulations 3 (3,0)
Concept of simulation modelling, selecting the appropriate input distribution, random number generation, simulation languages, output analysis, alternatives comparison, variance reduction technique, models of complex systems. Modelling Physical Phenomena and mathematical equations using MATLAB, matrix analysis, numerical visualization, building of graphical user interface, data analysis, case studies for simulation using any simulation software.

IE 5734 Quality Engineering 3 (3,0)
Principles of modern quality control techniques, KAIZEN by TQC/TQM, Management and Planning Tools, Affinity Diagrams, Interrelationship Digraph, Tree Diagram, Project teams, Project Management Techniques, Adventure based team building and leadership, Basic Tools, Prioritization matrices and Matrix diagrams, Organizational and cultural issues, Implementing change and new technologies, Deming, Baldrige and other total quality awards, Introduction to Six Sigma, Quality assurance Audit Programs, and ISO certification.

IE 5739 Cost and Management Accounting 3 (3,0)
Financial Accounting, Income statement and principles of accrual accounting, Balance sheet and recording of transactions, Accounting process, Revenue recognition, Inventory/cost of goods sold, Statement of cash flow, Long term assets/depreciation, long term debt, Current
Industrial Engineering

IE 5740  Total Quality Management 3 (3,0)
The concepts and principles of quality management, the quality management leading companies in the implementation of total quality management, techniques philosophies of modern quality leaders, the strategies used by some of the for process management, introduction and application of tools.

IE 5741  Project Evaluation & Feasibility Analysis 3 (3,0)

IE 5742  CAD/CAM 3 (3,0)
Computer methods in industrial design, Advanced computer geometric modeling, transformations and projection, CAD/CAM databases, Introduction to automated machine tools and cutting tools, tool path planning, Management of cutting tools, Numerical control, Motion control, Robotics, CNC machine tools programming, use of modelling software.

IE 5743  Business Forecasting 3 (3,0)
Forecasting alphabet, applications, classification of forecasting methods, Importance of sales forecast, Forecasting approaches (deterministic and probabilistic), Time series causal forecasting, Time series projective forecasting, Service level models, Information for dependent demand, Use of computer software in business forecasting.

IE 5744  Operations Management 3 (3,0)
Operations and productivity, operations strategy for competitive advantages, forecasting, design of goods and services, managing quality including SPC, capacity planning, location and layout strategies, supply chain management, inventory management including JIT, aggregate planning, MRP, maintenance and reliability, decision making tools, linear programming, transportation models, waiting lines model, learning curves, introduction to simulation, statistical tools for management.

IE 5745  Environmental Management & Safety 3 (3,0)
Professional and self development, Quality and resource planning, Integrated business risk management, Environmental and waste management, Workplace evaluation and control, Health and safety management and legislation, Environmental impact assessment, ISO 14000, reduction of carbon footprint. CAD/CAM databases, Introduction to automated machine tools and cutting tools, tool path planning, Management of cutting tools, Numerical control, Motion control, Robotics, CNC machine tools programming, use of modelling software.

IE 5747  Marketing Management 3 (3,0)
Introduction to the fundamental concepts of marketing, customer orientation, competition and core strengths, introductory finance, Marketing research and analysis, Marketing strategy, Implementation planning, Project, Process and supplier management, market segmentation, product life cycle, distribution networks, social marketing, product promotions, Marketing Mix.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits (Lecture, Tutorial, Practical)</th>
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<tbody>
<tr>
<td>IE 5754</td>
<td>Design and Analysis of Manufacturing Systems</td>
<td>3 (3,0)</td>
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<tr>
<td>IE 5758</td>
<td>Advanced Manufacturing Processes</td>
<td>3 (3,0)</td>
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<tr>
<td>IE 5762</td>
<td>Computer Integrated Manufacturing</td>
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<td>IE 5766</td>
<td>Artificial Intelligence</td>
<td>3 (3,0)</td>
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<td>IE 5770</td>
<td>Mathematics</td>
<td>3 (3,0)</td>
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<td>IE 5772</td>
<td>Technical Report Writing and Research Methodology</td>
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<td>IE 5780</td>
<td>Computer Applications</td>
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<td>IE 5784</td>
<td>Deterministic Optimization</td>
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IE 5754: Design and Analysis of Manufacturing Systems 3 (3,0)
Classification of manufacturing systems; High volume manufacturing systems; Flexible manufacturing systems; Assembly systems design and planning; Material handling systems; Automated storage/retrieval systems; Modelling manufacturing systems; Manufacturing management and strategies; Emerging trends in manufacturing systems engineering.

IE 5758: Advanced Manufacturing Processes 3 (3,0)
Non traditional machining and thermal cutting processes - Super finishing processes - Selection of manufacturing materials and processes - Joining and assembly processes - Design for manufacturing (processing and assembly) - Product and production relationships.

IE 5762: Computer Integrated Manufacturing 3 (3,0)
CIM strategy, CIM components, Concurrent engineering, GT and cellular systems, FMS, Robotic systems, Systems integration, Selection of CIM systems, Modeling and implementation of CIM systems, Enterprise resource planning, Future trends in CIM.

IE 5766: Artificial Intelligence 3 (3,0)
Introduction to AI, expert systems, knowledge-based systems, inductive logic programming, fuzzy sets and systems, evolutionary computation techniques, hyper heuristics, machine learning, hybrid intelligent systems, data mining and knowledge discovery, Genetic algorithm and artificial neural networks.

IE 5770: Mathematics 3 (3,0)
Approximations and error analysis, methods to find roots of non-linear algebraic equations, solution of systems of linear algebraic equations, deriving empirical equations to suit experimental data, numerical differentiation and integration, numerical solution of differential equations, the determination of Eigen values, Fourier analysis and its engineering applications.

IE 5772: Technical Report Writing and Research Methodology 3 (3,0)
Basics of technical writing process, Technical writing techniques and applications, definition and basics of research, Research purpose, Design of research methods, Identification of research problems, literature review, selection of data collection techniques, selection of representative sample, writing of research proposals, data collection and analysis techniques, limitations and significance of research techniques, quantitative and qualitative research procedures, writing of research reports, presentation skills, oral presentations.

IE 5780: Computer Applications 3 (3,0)
Computer hardware and software, Databases, Communication and networks, Constants and variables, Arithmetic operations, Intrinsic functions, Algorithm design, Flowcharts, and Pseudo codes, IF statements, Do loop, While loop, Data files, Formatted Input and Output, Logical and character data type, Arrays: onedimensional, two-dimensional, Subprograms: Functions and subroutines, Numerical Applications, Introduction to programming language.
Selection of an OR tool for a particular production/operations management application, Formulating deterministic optimization models, Defining objectives, decisions and constraints, Writing symbolic models and implementing those using optimization software, Using Excel data table functions to conduct sensitivity analysis, Interpretation of sensitivity tables, simplex tableaus, duality analysis, application of OR methods.

**IE 5788 Stochastic Optimization** 3 (3,0)

Approaches to optimization with uncertainty, stochastic optimization, and dynamic (multi-stage) stochastic optimization, two-stage and multistage stochastic programs, dynamic programming (Markov decision process) approach, finite and infinite horizon problems, deterministic DP approximation method for large-scale problems. Usage of computational techniques and applications.
Engineering Management Program

Engineering management program at Department of Industrial Engineering, University of Engineering and Technology, Peshawar, is designed for engineers who seek broad education in modern management techniques and tools for efficient operation of scientific and technical organizations to be ahead of competitors. In addition, this program is an interface between business sectors and engineering.

Management skills are mandatory for engineers to lead organizations effectively and make good technology related investment decisions. The top executives of the world class organizations need to have both technical and management skills for innovating and optimizing their products. Indeed, innovation and optimization of business processes leads to customer retention and satisfaction. In addition, engineering management tools enable engineers in conceiving an idea and shape them into reality by having business and entrepreneurial skills. Engineers with management knowledge also serve a mediator between technical and business people of the organization.

The Engineering management program will enhance the knowledge of those interested in this area and will also provide us with a platform for relevant research in the field of Engineering Management. Furthermore, this program will help students in becoming successful professionals in engineering disciplines and academia by giving the students the opportunity to present the industrial problems and discuss the business challenges.

Program Vision Statement:
"The Engineering Management program of Department of Industrial Engineering, UET Peshawar will be a world class graduate program where students, faculty, alumni can fulfill their passion for academic excellence and gearing towards nation's benefit."

Degree Program
- M.Sc in Engineering Management

Objectives
- To expand student's engineering knowledge and skills.
- To provide an understanding of a range of management skills, tools, and techniques essential for engineering management practice.
- To improve your communication skills to resolve disputes and in managing conflict.
- To discuss the important technological issues involved with engineering business and engineering management.
- To help student's in becoming successful professionals in engineering disciplines and academia.

Eligibility Criteria
Students of all engineering disciplines, B. Tech (Honors), MBA and BBA (Honors) with at least 16 years of education are eligible to take admission in the program.

Seat Allocation
The intake of students should be at least 30 on open merit and 10 on self-finance basis.
Degree Requirements

The Master’s degree program of Engineering Management at the Department of Industrial Engineering, University of Engineering and Technology, Peshawar, requires a total of 30 credit hours (including 24 credit hours of courses and 6 credit hours of research) are required to complete the Master’s Degree Program. The 24 credit hours of course work shall include a minimum of 18 credit hours from the core courses and 12 credit hours from elective courses. At least 6 core courses are required for MS Degree in Engineering Management.

List of Core Courses in Engineering Management Program

1. IES744 Operations Management
2. IES733 Project Management
3. IES725 Supply Chain Management
4. IES740 Total Quality Management
5. IES724 Organizational Behavior
6. IES791 Risk Analysis and Management
7. IES792 Business Analytics
8. IES793 Management of Technical Organizations
9. IES794 Technology and Innovation Management

List of Elective Courses in Engineering Management Program

IES728 Management Information System
IES741 Project Evaluation & Feasibility Analysis
IES743 Business Forecasting
IES723 Energy Management
IES745 Environmental Management and Safety
IES747 Marketing Management
IES739 Cost & Management Accounting
IES713 Benchmarking

IES727 Business Process Re-engineering
IES701 Engineering Economics
IES709 Human Resource Management
IES714 Operations Research
IES704 Inferential Statistics
IES790 Special Topic
IES795 Systems Engineering and Management
IES796 Knowledge Management
IES797 Decision Making with Uncertainty for Managers
IES798 Conflict Management and Negotiations

CONTENTS OF NEW CORE COURSES

IE5791 Risk Analysis and Management

Overview of risk modeling, assessment and management. The role of modeling in risk analysis process, Decision analysis, multiobjective trade-off analysis, defining uncertainty and sensitivity analysis, risk ranking and management, Risk of extreme events, fault tree analysis.

Recommended Books


IE 5792 Business Analytics

Overview of business analytics, data issues, introduction to data mining, data mining process, data mining tools, regression trees, optimization, marketing mix, capital budgeting, portfolio optimization, decision making under uncertainty, inventory management, capital investment analysis, market share estimation.
Recommended books:


IE 5793 Management of Technical Organizations

Management vs leadership, challenges in managing technical organizations, trends in management, management cultures, leadership lessons, legal issues in management, Modern challenges in partner ecosystem, management challenges across culture

Recommended Books:

1. Good to Great: Why Some Companies Make the Leap. And Others Don’t by Jim Collins, An imprint of Harpcollins publisher
2. Winning by Jack Welch, Harpcollins publisher

IE 5794 Technology and Innovation Management


Recommended Books:

1. Managing Engineering and Technology by Daniel L. Babcock and Lucy C. Morse, Pearson Education.

CONTENTS OF NEW ELECTIVE COURSES

IE 5795 Systems Engineering and Management

Core concepts in systems engineering; processes of system decomposition and integration; upfront conceptual design, rapid prototyping, structured testing, balanced work, lean processes, and design for manufacturability. The systems approach to designing, building, and operating complex engineering systems; requirements, functional decomposition, systems architecting, analysis of alternatives, project life cycle modeling, cost analysis, and technical performance measurement.
Recommended Books:

1. Frederick Hillier and Mark Hillier, 2007. Introduction to
Department of Mechanical Engineering

Mechanical Engineering encompasses the generation, conversion, transmission, and utilization of mechanical and thermal energy as well as the design, construction, and operation of all kinds of machines. Of all the engineering disciplines, mechanical engineering offers the greatest breadth, flexibility, and individuality. The professions taken up by mechanical engineers are very diverse and touch every walk of life. One usually thinks of mechanical engineers finding employment in traditional industries such as the automotive, power generation and manufacturing, but it must be kept in mind that the high-tech "smart products" combining computer chips into mechanical devices are also designed and manufactured by mechanical engineers.

Mission

The mission of the Mechanical Engineering Department is to produce leaders in mechanical engineering for the 21st century by providing each student with a balance of intellectual knowledge and practical experience in order to prepare the graduates to address a variety of societal needs. The programme prepares each student with higher competencies as a practicing mechanical engineer, or for higher studies in engineering. With solid grounding in the principles and practice of mechanical engineering, graduates are ready to engage in a lifetime of learning about employing new concepts, technologies, and methodologies.

The Department of Mechanical Engineering was conceived in 1952 as part of the Faculty of Engineering, Peshawar University, which was later upgraded to the status of a full-fledged Engineering University in 1980. The postgraduate programme in the department started in 1991 and offers a Masters degree in Mechanical Engineering as well as Ph.D.

CHAIRMAN
Prof. Dr. M. Naeem Khan  Ph.D. (Pak)

PROFESSORS
Prof. Dr. M. Naeem Khan  Ph.D. (Pak)
Prof. Dr. M. A. Irfan  Ph.D. (USA)
Prof. Dr. Rizwan M. Gul  Ph.D. (USA)
Prof. Dr. Hamid Ullah  Ph.D. (Thailand)
Prof. Dr. Afzal Khan  Ph.D. (USA)

ASSOCIATE PROFESSORS
Engr. Iftikhar Ahmad  M.Sc. (Pak)
Engr. M. Masood Ahmad  M.Sc. (Pak)
Dr. Abdul Shakoor  Ph.D. (UK)

ASSISTANT PROFESSORS
Engr. Muhammad Ali Arif  M.Sc. (UK)
Dr. S. Shaukat Ali Shah  Ph.D. (Thailand)
Dr. Muhammad Ali Kamran  Ph.D. (UK)
Dr. M. Alam Zaib Khan  Ph.D. (UK)
Dr. Feroz Shah  Ph.D. (Pak)
Dr. M. Sadiq Khattak  Ph.D. (USA)
Dr. Umar Ibrahim  Ph.D. (USA)
Dr. Kareem Akhtar  Ph.D. (USA)
Dr. Naveed Ullah  Ph.D. (S.Korea)
Engr. Naveed Ahmad  M.Sc. (USA)

LECTURERS
Engr. Tabassum Yasmin  M.Sc. (Pak)
Engr. Adeel Ahmad  M.Sc. (Pak)
Engr. Fazli Yazdan  M.Sc. (Pak)
Engr. Zeeshan Zahir  M.Sc. (Pak)
Engr. Adnan Rasheed  M.Sc. (Pak)
Engr. Qazi M. Yaseen  M.Sc. (Pak)
Engr. Ismail Khan  M.Sc. (Pak)
Engr. Shafi-ud-Din  M.Sc. (Pak)
Engr. M. Kaleemullah Khail  M.Sc. (Pak)
Engr. Numan Khan  M.Sc. (Pak)

LAB ENGINEER
Engr. M. Usman Khan  M.Sc. (Pak)
Engr. M. Arslan Khan  M.Sc. (Pak)
RESEARCH AREAS
Current research in the department focuses on die-casting, design of renewable energy systems, implant materials characterization, driving safety issues, and technology management. The department boasts well-qualified permanent faculty with Ph.D. and Master degrees from both USA and UK. Extensive computational and laboratory facilities are available for teaching and research purposes. The laboratories include an Impact Research Lab, a Rapid Prototyping facility, a Metallurgy Lab with a 10-ton computerized Universal Testing Machine, Advanced Manufacturing Lab, Dynamics and Control Lab, etc. A seminar library provides latest books of interest to researchers and postgraduate students. This is in addition to the Central Library, which stocks mostly undergraduate books.

INDUSTRIAL INTERACTION
The Department maintains regular interaction with the local industry for solving industrial problems. Courses in latest engineering techniques of interest to the industry are offered regularly and can also be arranged on request. Such courses include Finite Element Analysis using ANSYS, Solid Modelling using ProE, Condition Monitoring of Rotating Machinery, Experimental Stress Analysis, Computer-Aided-Drafting using AutoCAD, etc. Several research projects sponsored by industry have been undertaken by the faculty.

POST GRADUATE PROGRAMME
The Department offers Master’s degree in Mechanical Engineering in the following three specializations:
1. Mechanical Engineering Design
2. Dynamics and Control
3. Materials Engineering
In addition to core courses in each specialization, elective courses must be taken in consultation with advisor from amongst the approved courses. However, a maximum of one course can be taken out of the management related courses.

Core Courses for MS Mechanical Engineering Design
ME 5303  Finite Element Analysis
ME 5305  Experimental Stress Analysis
ME 5312  Advanced Stress Analysis
ME 5313  Continuum Mechanics
ME 5375  Product Design and Development
ME 5306  Fatigue of Metal Structures

Core Courses for MS Dynamics and Control
ME 5332  Advanced Mechanical Vibration
ME 5335  Design of Mechanisms
ME 5338  Modeling of Dynamic Systems
ME 5339  Advanced Control Engineering
ME 5371  Modeling and Simulation
ME 5336  Industrial Robotics

Core Courses for MS Materials Engineering
A minimum of 6 courses must be taken from the following list of core courses:
ME 5351 Characterization of Materials
ME 5352 Materials Thermodynamics
ME 5353 Composite Materials
ME 5354 Heat Treatment of Metals and Alloys
ME 5355 Polymer Science and Engineering
ME 5356 Biomaterials
ME 5357 Evaluation Techniques & Instrumentation
ME 5365 Phase Equilibria and Microstructures
ME 5391 Applications and Selection of Materials
ME 5392 Mechanical Behavior of Materials
Doctoral programme of studies was started in the department in 2002 and is currently focused on the following areas of specialization:

1. Manufacturing Processes
2. Design optimization
3. Renewable energy systems
4. Advanced materials engineering
5. Design and manufacturing methods
6. Thermal and Fluid Sciences
7. Nano technology

LIST OF APPROVED COURSES

ME 5301 THEORY OF ELASTICITY (3)

Recommended Books
2. Elasticity, Tensor and Dyadic Approach by Pe-Chi-Chou, John Wiley
4. Elasticity by J.R. Barber, Kuwler Academic Press

ME 5303 FINITE ELEMENT ANALYSIS (3)

Recommended Books
1. Introduction to Finite Element Method by Frank Stasa, CBS
2. Finite Element Procedures by Bathe, Prentice Hall
3. ANSYS Manuals, ANSYS Publication

ME 5305 EXPERIMENTAL STRESS ANALYSIS (3)
Revision of fundamental concepts of stress and strain in two and three dimensions.


**Recommended Books**

1. *Experimental Stress Analysis* by J.W. Dally and W.F. Riley

**ME 5306 FATIGUE OF METALS AND STRUCTURES (3)**


**Recommended Books**

1. *Failure of Materials in Mechanical Design: Analysis, Prediction and Prevention* by J.A. Collins
2. *Engineering Consideration of Stress-Strain and Strength* by Robert C. Juvinall

**ME 5308 MECHANICS OF FIBER REINFORCED COMPOSITE MATERIALS (3)**

Classification and characteristics of composite materials, Mechanical behavior of composite materials, Manufacturing processes of composite materials, Advantages of Fiber reinforced composite materials, Macro-Mechanical behavior of a lamina, Stress-Strain relations for plan stress in orthotropic materials, Stress strain relations for lamina of arbitrary orientation, Strengths of an orthotropic lamina, Biaxial strength criteria for an orthotropic lamina, Micro Mechanical behavior of a lamina, Mechanics of material approach stiffness and strength, Macro-Mechanical behavior of a laminate, Classical lamination theory, Various laminate configurations, Design of laminates, Strength of laminates, Failure theories for composites.

**Recommended Books**


**ME 5309  FRACTURE MECHANICS (3)**

Recommended Book
Fracture Mechanics by T.L. Anderson, CRC Press

**ME 5312  ADVANCED STRESS ANALYSIS (3)**

Dynamic Events in Space.

Recommended Book

**ME 5313 CONTINUUM MECHANICS (3)**
Vector and Tensors: Vector and tensors, indicial Notation, Rectangular Cartesian Components, Tensor Properties, Vector and Tensor Calculus, Stress: Body Force and Surface Force, Traction or Stress Vector, Principal Axes of Stresses and Principal Stress, Invariants, Mohr's Circle and Lame's ellipsoid.
Strain and Deformation: Small Strain and Rotation in three dimension, Kinematics of a continuous medium, Rate of deformation tensor, Finite Strain and Deformation, Eulerian and Lagrangian formulation, Geometric measure of Strain, Relative deformation Gradient. Rotation and Stretch Tensors, Compatibility Condition, Determination of Displacements.

**Recommended Books**
1. Introduction to the Mechanics of a Continuous Medium L. E. Malvern Prentice Hall.
2. Continuum Mechanics by A.J.M. Spencer, Longman

**ME 5314 METAL FORMING (3)**

**Recommended Books**
2. Theory of Plasticity by J. Lubliner
3. Mechanical Metallurgy by Dieter

**ME 5321 COMPRESSIBLE FLOWS (3)**
Review of the Thermodynamic and Fluid Mechanics quantities, Flow Regimes, Integral and Differential
forms of the NS (Navier Stokes).


Two Dimensional Oblique Shocks, Reflection of Shocks from Solid Boundary, Intersection of Shocks, Pressure Deflection Diagrams, Expansion Waves and their relations, Shocks Expansion Theory.

Quasi 1D flow, Flow through Converging and Convergent-Divergent nozzles, Diffusers Waves Reflections.


Recommended Book

**ME 5322** COMPUTATIONAL FLUID DYNAMICS (CFD) (3)

Derivation of the NS equations, Conservation and Non Conservation Forms, Shock Capturing and Shock Fitting.

Mathematical Behaviour of PDEs, Eigen Value Method, Types of Flow (Parabolic, Elliptical, Hyperbolic)

Discretisation methods, Finite Difference equations, Explicit and Implicit approaches, Errors, Stability Analysis.

Grids, Transformation of equations, Metrics and Jacobians, Finite Volume Method.

Simple CFD Techniques: Lax-Wendroff Techniques, MacCormacks Techniques, Alternating Direct Implicit (ADI) Technique.

Introduction to commercially available CFD Software

**Recommended Books**


**ME 5331** DYNAMICS OF MECHANISMS (3)

**Prerequisite:** ME 5335 Design of Mechanisms.


**Recommended Books**


ME 5332  ADVANCED MECHANICAL VIBRATION (3)

Recommended Books

ME 5333  VIBRATION MEASUREMENT AND ANALYSIS (3)

Recommended Books
2. Nakra, Yadava, Thuestad, Vibration Measurement and Analysis, National Productivity Council, New Delhi, India.

ME 5334  MODAL ANALYSIS (3)
Introduction to Robotics, Types of Robots, Motions of Robot, Parts of Robot, Robotics Applications Growth and Cost, Drive Methods, Sensors for Robots. Spatial Description and Transformation, Forward Kinematics (To Compute The Position and Orientation of the EndEffect of the Manipulator) Inverse Kinematics (Given the Position And Orientation of the EndEffect Calculate All Possible Sets of Joint Angle Which Could be Used to Attain This Given Position and Orientation) Jacobean (It Specifies a Mapping From Velocities in Joint Space to Velocities in Cartesian Space).

Recommended Books

1. Introduction to Robotics: Mechanics and Control By John J. Craig

ME 5338  MODELING OF DYNAMIC SYSTEMS (3)

Introduction to Simulink.

Differential equations, transfer functions, block diagrams and simulation of: electromechanical elements, fluid elements, thermal elements and power conversion elements. Linearization.

Introduction to frequency domain analysis: Fourier series and Fourier transform, Spectra of different signals.


Recommended Books


Recommended Books

1. System Dynamics: modeling, analysis, simulation, design, E O Doeblin, Marcel Dekker

ME 5339 ADVANCED CONTROL ENGINEERING (3)
Prerequisite: ME5338 Modeling of Dynamic Systems
Frequency Response Methods: Frequency response plot and measurements, performance specifications in the frequency domain, Log magnitude and Phase diagrams, mapping contours in the s-plane, Nyquist criterion, system bandwidth.
Control System Design by Frequency Response: Lag-Lead Compensation, System design using integrated network, system with pre-filters. PID Controls: Tuning rules for PID controllers, Zero-placement approach to improve response. Analysis and design of control systems in state space: State space representation of transfer function, Controllability, Observability, Pole placement using state feedback, Ackermann's formula, internal model design.
Note: Matlab and Simulink will be used throughout the course.

Recommended Books

2. Modern Control Engineering by Katsuhiko Ogata 4th edition

ME 5341 ADVANCED HEAT TRANSFER (3)
Review and Engineering applications of Heat Transfer.
Forced Convection over Cylinders, Spheres and Tube Banks, Free Convection over Plates and Cylinders.

Recommended Books

2. Heat and Mass Transfer by Frank P. Incropera
ME 5342 ENERGY ENGINEERING (3)
- Use of Commercial Software for energy benchmarking.

Recommended Books

ME 5352 MATERIALS THERMODYNAMICS

Recommended Books:
1. Thermodynamics of Materials (David V. Ragone)
2. Introduction to Thermodynamics of Materials (D. R. Gaskell)
3. Thermodynamics, an Advanced Text for Material Scientists (J. Hudson)
4. Physical Metallurgy Principles (Reed-Hill)

ME 5353 COMPOSITE MATERIALS
Recommended Books:

2. An Introduction to Composite Materials by D. Hull
3. Fiber-Reinforced Composites by P. K. Mallick

**ME 5354  HEAT TREATMENT OF METALS AND ALLOYS**

Relation of structural changes and kinetics of transformation to continuous heat treatment processes. Controlled atmosphere for heat treatment. Applications of thermodynamics and mass transfer theory to the heat treatment processes.

Recommended books:

1. Physical Metallurgy by Avener
2. ASM Handbook on Ferrous materials

**ME 5355  POLYMERS SCIENCE AND ENGINEERING**

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

Recommended Books:

1. Principles of Polymer Chemistry by Paul J. Flory.

3. Introduction to Polymers by R. J. Young and P. A. Lovell

**ME 5356  BIOMATERIALS**

Applications of materials science and engineering to artificial materials in the human body with the objective of detailed understanding of synthetic materials and biopolymers. Biocompatibility and its consequences on tissue–implant interfaces. Design and development of new implant materials, smart drugs, and drug delivery systems.

Recommended Books:

1. Buddy D. Ratner, Biomaterials Science: An Introduction to Materials in Medicine 2nd Ed. 2004

**ME 5357  EVALUATION TECHNIQUES & INSTRUMENTATION**

Compositional analysis employing AES, ESCA and Electron Probe Microanalysis.

Recommended Books:

1. David D. Brandon and Wayne D. Kaplan Microstructural Characterization of Materials
4. Adam J. Schwartz, Mukul Kumar, Brent L. Adams, and David P. Field Electron Backscatter Diffraction in Materials Science by 2009

ME 5361 NUMERICAL METHODS FOR ENGINEERS (3)


Recommended Books

1. Numerical Methods for Engineers By Steven C. Chapra & Raymond P. Canale.

ME 5362 COMPUTER APPLICATIONS IN MECHANICAL ENGINEERING (3)


Recommended Books

1. Inside Pro-Engineer by Utz and Ulman, Onward Press, USA.
2. Introduction to MATLAB by D.M. Etter, McGraw Hill.
3. MATLAB Manuals.

ME 5363 ENGINEERING DESIGN OPTIMIZATION (3)


Recommended Books


ME 5364 CONDITION MONITORING OF ROTATING MACHINERY (3)


Recommended Books

3. Handbook of Condition Monitoring by Alan Davis, Chapman and Hall.

ME 5365 PHASE EQUILIBRIA AND MICROSTRUCTURE (3)


Recommended Books

1. Mechanical Metallurgy by George E. Dieter, McGraw Hill
2. The Science and Engineering of Materials by Donald R. Askland

ME 5367 HUMAN RESOURCE MANAGEMENT (3)


Recommended Books


ME 5366 FINANCIAL ANALYSIS (3)


Recommended Books


ME 5368 TOTAL QUALITY MANAGEMENT (3)


Recommended Books

1. Total Quality Management by James R. Evans, American Management Assoc.

**ME 5369 DIGITAL CONTROL SYSTEMS (3)**

**Prerequisite:** ME5339 Advanced Control Engineering

Introduction to Discrete-Time Control Systems: Digital control systems, Quantizing and quantization error, Data acquisition and distribution. The Z Transform: Z Transform, Z transform of elementary functions, its properties and theorems, Inverse z transform. Z-plane Analysis of Discrete-Time Control Systems: Impulse sampling and data hold, obtaining the z transform by the convolution integral method, Reconstructing original signal from sampled signals, Pulse transfer function, Digital controllers and filters.

Design of Discrete Time Control System: Mapping between s plane and z plane, Stability analysis of closed loop system in z plane, Transient and steady state response analysis, Root locus design, Analytical design method.

State Space Analysis of Discrete-Time Control System Pole Placement And Observer Design: Controllability, Observability, design via placement, State observers, Servo systems

**Recommended Books**

1. Discrete-Time Control Systems by Katsuhiko Ogata, 2nd edition


**ME 5370 INDUSTRIAL AUTOMATION (3)**

Recommended Books

2. CAD/CAM From Principles to Practice by Chris McMahon and Jimmie Browne, Addison Wesley Publishing Company.

ME 5371 MODELING AND SIMULATION (3)
Introduction to Modeling and Simulation


Data analysis and statistics. Regression and Curve fitting. Fourier Analysis.


Recommended Books

1. Introduction to Matlab for Engineers, by W J Palm III.

ME 5372 RANDOM VIBRATION (3)

Prerequisite: ME 5332 Advanced Mechanical Vibration


Recommended Books

3. An Introduction to random Vibrations, D E Newland, Longman.
4. Introduction to random Vibrations, N C Nigam, MIT Press.

ME 5373 ORGANIZATIONAL BEHAVIOR FOR ENGINEERS (3)

Leadership, Contemporary Issues in Leadership, Power and Politics, Conflict and Negotiation, Organizational Culture, Stress in Organizations and its Management.

Recommended Books
2. Understanding and Managing Organizational Behavior, 4th Ed. by George & Jones.
3. Managing Behavior in Organizations, 4th Ed. by Jerald Greenberg

ME 5374 PROBLEM SOLVING AND DECISION MAKING (3)

Recommended Books
Making Hard Decisions, 2nd Ed. by Robert T. Clemen

ME 5375 PRODUCT DESIGN AND DEVELOPMENT (3)

Mini Project: The course includes a mini project of Product Design and Development with weekly assignments leading to complete design of a new product on Pro-Engineer.
Software: Pro-Engineer

Recommended Books
1. CAD/CAM by McMohen & Brownie.
3. Total Design by Pugh.

ME 5383 ADVANCED CAD/CAM (3)

**Recommended Books**


**ME 5384  ECO-DESIGN AND MANUFACTURING SYSTEMS (3)**


**Recommended Books**


**ME 5385  ARTIFICIAL INTELLIGENCE IN DESIGN AND MANUFACTURING (3)**


**Recommended Books**

- Artificial Intelligence: A Guide to Intelligent Systems by Michael Negnevitsky

**ME 5391  APPLICATIONS AND SELECTION OF MATERIALS (3)**


**Recommended Books**

ME 5392 MECHANICAL BEHAVIOR OF MATERIALS (3)

Recommended Books

ME 5390 SPECIAL TOPICS RELATED TO MECHANICAL ENGINEERING DESIGN (3)

ME 5398 TECHNICAL REPORT WRITING AND RESEARCH METHODOLOGY (3)
Basics of Technical Writing Process, technical writing techniques and applications, definitions and basics of research, research purpose, design of research methods, identification of research problems, literature review, selection of data collection techniques, selection of representative sample, writing of research proposals, data collection and analysis techniques, Qualitative and Qualitative research procedures, writing of research reports, presentation skills, oral presentations.

ME 5399 MASTER'S THESIS (6)
ME 6399 Ph.D. THESIS (1-9)
INTRODUCTION
Mechatronics is a multidisciplinary field of engineering comprising of mechanical, electronic, control, computer, system design and software engineering. The integration of several engineering disciplines and technologies leads to the design of innovative components and systems to produce autonomous and smart products.

The aim of the Postgraduate program at the institute of Mechatronics is to develop expertise in the areas of robotics, bio-Mechatronics, intelligent control systems, smart sensors and actuators, and Micro/Nano Electro-Mechanical Systems (MEMS & NEMS) for automotive, aviation and aerospace, transportation, manufacturing and production engineering, energy, industrial, biomedical and healthcare applications.

MISSION
The mission of the post graduate program at Institute of Mechatronics is to perform leading edge research and to groom quality researchers for the country's needs in the field of education, research and industry. To establish state of the art education and research environment for outstanding graduates, industry and community.

OBJECTIVES
- To actively participate in providing solutions to the existing and future needs of local, national and international industries.
- To develop research, technical writing and communication skills needed for scientific papers, articles, proposals, reports and presentations in national and international scientific workshops, seminars, conferences and journals.
To prepare excellent Mechatronics researchers and experts for the national research institutions, universities and industries.

To establish an effective collaboration with local, national and international research institutions, universities and industries related to Mechatronics.

**ELIGIBILITY CRITERIA FOR ADMISSION IN M.Sc IN MECHATRONICS ENGINEERING**

Bachelor’s degree in any of the following disciplines:

- Mechatronics Engineering
- Mechanical Engineering
- Electrical / Electronics / Telecom Engineering
- Industrial Engineering
- Computer Software/Systems/Computer Engineering

**FIELDS OF SPECIALIZATION AND SEAT ALLOCATION**

The master's program at the institute of Mechatronics offers specialization in Automation and Control.

**Seat allocation (per semester) for M.Sc in Mechatronics Engineering**

<table>
<thead>
<tr>
<th>Specialization</th>
<th>Seats reserved for open merit</th>
<th>Seats reserved for rationalized fee basis</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automation and Control</td>
<td>10</td>
<td>10</td>
<td>20</td>
</tr>
</tbody>
</table>

**CORE COURSES**

There are twenty three core courses for the specialization in Automation and Control that must be taken by the students.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MtE 5101</td>
<td>Advanced Manufacturing Automation</td>
<td>3</td>
</tr>
<tr>
<td>MtE 5103</td>
<td>Reconfigurable Machine Tool Design</td>
<td>3</td>
</tr>
<tr>
<td>MtE 5104</td>
<td>Laser Applications in Engineering</td>
<td>3</td>
</tr>
<tr>
<td>MtE 5105</td>
<td>Drives &amp; Control in Industrial Automation</td>
<td>3</td>
</tr>
<tr>
<td>MtE 5106</td>
<td>Micro-fabrication</td>
<td>3</td>
</tr>
<tr>
<td>MtE 5107</td>
<td>Advanced Mechatronics Systems Design</td>
<td>3</td>
</tr>
<tr>
<td>MtE 5108</td>
<td>Advanced Industrial Control</td>
<td>3</td>
</tr>
<tr>
<td>MtE 5109</td>
<td>Advanced Micro-Electromechanical Systems</td>
<td>3</td>
</tr>
<tr>
<td>MtE 5110</td>
<td>Advanced Micro &amp; Nano Fabrication Technology</td>
<td>3</td>
</tr>
<tr>
<td>MtE 5111</td>
<td>Microrobotics</td>
<td>3</td>
</tr>
<tr>
<td>MtE 5113</td>
<td>Advanced Control Engineering</td>
<td>3</td>
</tr>
<tr>
<td>MtE 5114</td>
<td>Computer Applications in Robotics</td>
<td>3</td>
</tr>
<tr>
<td>MtE 5115</td>
<td>Biomechatronics</td>
<td>3</td>
</tr>
<tr>
<td>MtE 5116</td>
<td>Multidisciplinary Engineering Design Optimization</td>
<td>3</td>
</tr>
<tr>
<td>MtE 5119</td>
<td>Robotics I</td>
<td>3</td>
</tr>
<tr>
<td>MtE 5120</td>
<td>Advanced Robotics</td>
<td>3</td>
</tr>
<tr>
<td>MtE 5121</td>
<td>Robotics II</td>
<td>3</td>
</tr>
<tr>
<td>MtE 5122</td>
<td>Fuzzy Logic Control</td>
<td>3</td>
</tr>
<tr>
<td>MtE 5123</td>
<td>Advanced Digital Systems</td>
<td>3</td>
</tr>
<tr>
<td>MtE 5125</td>
<td>Machine Learning</td>
<td>3</td>
</tr>
<tr>
<td>MtE 5128</td>
<td>Advanced Digital Signal Processing</td>
<td>3</td>
</tr>
<tr>
<td>MtE 5129</td>
<td>Digital Image Processing</td>
<td>3</td>
</tr>
<tr>
<td>MtE 5130</td>
<td>Machine Vision</td>
<td>3</td>
</tr>
</tbody>
</table>

**DOCTORAL (PhD) PROGRAM**

The research areas that are open to doctoral students in the institute of Mechatronics include but are not limited to:

1. Intelligent Transportation
2. Robotics
3. Laser and its applications in industry
4. Bio-Mechatronics
5. Intelligent control systems
6. Smart sensors and actuators
LIST OF APPROVED COURSES

**MtE 5101 ADVANCE MANUFACTURING AUTOMATION (3)**


Recommended Books:


**MtE 5102 ENGINEERING PROJECT MANAGEMENT (3)**


Recommended Books:


**MtE 5103 RECONFIGURABLE MACHINE TOOL DESIGN (3)**

the Design of Reconfigurable Machine Tools,
Reconfigurable Fixtures for Automotive Engine
MtE 5110 ADVANCED MICRO & NANO FABRICATION TECHNOLOGIES (3)

Principles of micro and nano fabrication, material and process selection for micro fabrication, Integrated circuit (IC) technology, silicon micromachining, micromachining high aspect ratio structures, LIGA, microfabrication using X-rays lithography, maskless fabrication techniques, micro-Electric Discharge Machining (EDM), mechanical processing for micro fabrication, laser micro and nano fabrication; nanostructuring, nano imprinting methods, carbon nano tube (CNT), fabrication techniques for CNT's, Applications of CNT's to MEMS/NEMS and other emerging devices.

Recommended Books:
1. Micro and nanomanufacturing by Mark J. Jackson, Springer, USA.

MtE 5111 MICROROBOTICS (3)

Microsystems technology and microrobots, application and future prospects of microrobots, Classification of microrobots, Microgripper Technologies: Overview, microassembly with the help of microrobots, Autonomous or Semiautonomous microrobots.

Recommended Books:
1. Microrobotics: methods and applications by Yves Bellouard, CRC Press, USA.
4. Automated nanohandling by microrobots by Sergej Fatikow, Springer, USA.

MtE 5112 NANOROBOTIC SYSTEMS (3)


Recommended Books:
2. Nanomedicine and Nanorobotics by Klaus D. Sattler, CRC Press, USA.

MtE 5113 ADVANCED CONTROL ENGINEERING (3)

Systems response analysis: General structure of controllers; First order systems; Higher order systems; Routh's stability criterion; Integral and derivative control actions: effects on systems performance; Steady-state errors.

Root-locus method: The concept of root-locus; Rules for constructing root-loci; Root-locus analysis of
control systems; Control-systems design by the root-locus approach.


**MtE 5119 ROBOTICS I** (3)
Introduction to Robotics, Types of Robots, Motions of Robot, classification Kinematics: homogeneous transformations, manipulator kinematic equations, forward and inverse kinematic solution methods, Introduction to dynamics of manipulators.

**Recommended Books:**

**MtE 5121 MULTI-ROBOT SYSTEMS** (3)
A research based course on Multi-robot systems: Cooperation, coordination, fault tolerance, Techniques and approached used for multi-robot systems. Market based approaches, Artificial Immune system based approaches.

**Recommended book:**
There is no text book. Journal papers in the respective area will be used for references.

**MtE 5122 FUZZY LOGIC CONTROL** (3)
Review of traditional control techniques and comparison with intelligent control, methods of representing and processing knowledge;
conventional sets and crisp logic, fuzzy logic, fuzzy logic control, hierarchical fuzzy control, control
MtE 5131 TECHNICAL REPORT WRITING AND RESEARCH METHODOLOGY (2)
Basics of technical writing process, technical writing techniques and applications, definition and basics of research, research purpose, design of research methods, identification of research problem, literature review, selection of data collection techniques, selection of representative sample, writing of research proposals, data collection and analysis techniques, limitation and significance of research techniques, quantitative and qualitative research procedures, writing of research reports, presentation skills, oral presentations.

Recommended Books:
2. Technical Writing for Success by Darlene Smith-Worthington and Sue Jefferson, South-Western Cengage Learning, USA.

MtE 5132 PATTERN RECOGNITION (3)

Recommended Books:

Journals and Magazines
1. International Journal of Computer Vision
3. Pattern Recognition

MtE 5197 SPECIAL TOPICS RELATED TO MECHATRONICS ENGINEERING (3)

MtE 5198 MASTER'S THESIS (6)
MtE 5199 Ph.D. THESIS (1-9)
The Department of Mining Engineering was established in 1974. It has been offering PostGraduate degree in Mining Engineering since 1991. During the earlier years the department offered research specializations within the mining discipline in rock Mechanics and mineral processing. With the passage of time the faculty of this department obtained higher qualification in their respective fields from abroad. New venues for research were introduced and broad spectrum of research specialization is now being offered in areas of ventilation system in mines, occupational safety and health of workers, mine planning and design and mineral processing. The spectrum of courses has also broadened and now world class curriculum is offered incorporating modern software applications in Mining industry. The faculty has earned its reputation in mining not only on National level but also at International level. Computer applications in mining, advancement in quarrying methods, research in health & safety, application of rock mechanics in tunneling and underground excavations and demand for coal as energy resource have formed a vital base for this development.

A number of professionals, serving in the industry have taken advantage of our M.Sc programme. Our M.Sc programme is specially oriented for professionals working in the industry, therefore the classes are accustomed to the requirements and development of the local mining industry. Over the years the postgraduate students have taken a number of M.Sc projects that have facilitated the industry. The research is applied to enhance the skills and applied knowledge of students who serve the public and private sector mining industry. The department also offers Ph.D. program in core subjects of mining engineering.

Research projects for economic beneficiation of copper ore deposit of North Waziristan Agency, up-gradation of local coal resources for its use in the cement industry identifying causes and means of control of respiratory diseases in coal mine workers in Khyber Pakhtunkhwa, Block modeling and resource estimation of mineral deposits, rock mechanics applications for solving mining and tunneling problems in Khyber Pakhtunkhwa province have been successfully completed.
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RESEARCH PROJECTS AND FACILITIES
The Department is actively involved in various research projects of national importance related to different areas of Mining Engineering.

The department has completed following R&D Projects:

1. Investigation into incidence of pneumoconiosis and related diseases among mine workers of KP.
2. Development of block model for cement quarry operations.
3. Re-cleaning of concentrate from the basic flotation circuit of North Waziristan copper ore at pilot scale.
4. Development and application of extraction techniques for mining of dimensional blocks of marble.
5. Development of cutoff grade optimization software with consideration of dynamic metal price, cost escalation and stock piles during mine life.
6. Determination of index and geo-chemical properties of marble of KP.
7. Designing, fabrication and installation of mineral concentration plant.
8. Design and safety improvements of underground coal mines in Cherat area, KP.
9. Beneficiation studies of Malakand low grade graphite ore for industrial use.

INTERACTION WITH INDUSTRY
The department has a strong research linkage with the following Organizations:

2. Pakistan Mineral Development Corporation (PMDC).
3. Pakistan Stone Development Company (PASDEC).
4. Agha Khan Rural Support Programme (AKRSP), Chitral
5. Pakistan Science Foundation
6. DG Khan Cement Company Ltd.
7. Kohat Cement Factory, Kohat
8. Cherat Cement Factory, Nowshera
9. Marble Mining Organizations in Pakhtunkhwa
10. FATA Development Authority Livelihood Program.
11. Frontier Works Organization (FWO).
LIST OF APPROVED COURSES

**MinE 5510 MINE ADMINISTRATION AND LABOUR RELATIONS (3)**

**MinE 5511 LOSS CONTROL AND SAFETY IN MINING (3)**
Mining as a hazardous industry. Hazards of mining operations. Causes of mine accidents, concept of accident prevention, Basic principles of accident prevention, Safety performance measurement, importance of accident investigation, accident investigation techniques, concept of total loss control, loss control through safety management, Cost of accidents, cost analysis of mine accidents.

**MinE 5512 TECHNICAL REPORT WRITING AND RESEARCH METHODOLOGY (3)**
Basics of technical writing process; Technical writing techniques and application; Definition and basics of research, research purpose; Design of research methods, identification of research problem, Literature review, selection of data collection techniques, Selecton of representative sample, writing of research proposals, Data collection and analysis techniques, limitations and significance of research techniques; quantitative and qualitative research procedures; writing of research reports; presentation skills, oral presentations.

**MinE 5513 APPLICATIONS OF ERGONOMICS TO OCCUPATIONAL SAFETY AND HEALTH (3)**
Introduction to Ergonomics, Basic principles of Ergonomics; Principles of workplace design; job analysis and workplace assessment, Design of Physical environment; Human-machine interaction, work organization; system design; engineering controls, administrative controls.

**MinE 5515 ADVANCED MINERAL PROCESSING (3)**

**MinE 5516 HAZARDOUS WASTE MANAGEMENT (3)**
Introduction, historical roots, classification, regulatory process, fate and transport methods of
contaminants, toxic effects and carcinogens, environmental audits, pollution prevention, physical treatment process, biological methods of treatment, stabilization methods, thermal methods, land disposal, quantitative risk assessment, site and sub surface characterization, case studies.

MinE 5517 ENVIRONMENTAL CONTROLS IN MINING (3)
Introduction to environmental pollution, environmental pollution laws and regulations, National Environmental Quality Standards (NEQS), types of pollutants and pollution sampling and measuring techniques, ecological impacts and reclamation of mined land, sources of acid mine water, drainage and controls, vibration and air blast due to blasting and its controls.

MinE 5520 COAL PREPARATION (3)

MinE 5525 ADVANCED ROCK MECHANICS (3)

MinE 5530 ADVANCED MINE VENTILATION NETWORKS AND ENVIRONMENT (3)

MinE 5535 COMPUTER APPLICATION IN MINING & ADVANCED PROGRAMMING (4)

MinE 5540 OPERATIONS RESEARCH (3)

MinE 5545 HYDROMETALLURGY (3)
Surface chemistry of mineral particle.
Chemistry of flotation and agglomeration. Amalgamation and cyanidation.

MinE 5550 MINERAL PROCESS DESIGN (3)
Mineralogical approach of the ore and material minerals with respect to process selection. Advanced technique of liberation studies process selection and process testing for reproducing of test results. Economic and technical evaluation of the process selected. Pilot plant testing and statistical feasibility studies. Detailed discussions of standard flow sheets and techniques of designing.

MinE 5551 FINE PARTICLE SCIENCE AND PROCESSING (3)
Particle characterization, particle dimensions (geometric and statistics dimensions), physical and geometric equivalent diameters, specific surface, particle shape analysis, particle size distribution and its types, cumulative and differential distributions, GGS and RRSB distributions, Sauter diameter.
Characterization of separation process, separation efficiency, separation limits, particle mechanics in sieving. Centrifuges and hydrocyclones.
Overview of two phase maxing processes, solid-solid and solid-liquid mixing, characterization of mixing quality.
Comminution, batch and continuous size reduction.
Fine particles flotation and flocculation.
Storage and flow of bulk materials: Silos, resting bulk materials force balance, flowing bulk materials, Silos design.
Fluids solids flow, single particle in fluid, flow through solid beds.
Agglomeration, adhesion forces, built up agglomeration, advantages and application of particle size increase.
Bulk solids properties, solid-liquid separation, derivation and solution of filtration equation, filter capacity, sedimentation.

Books:

Reference Books:
i. Fine particles processing Vol I and II by Somasunderan AIME publisher.
ii. Fundamentals of Particle Technology by R.D. Holdish, Midland information technology publishing, 2002.

MinE 5555 ANALYSIS OF DEFORMED GEOLOGICAL STRUCTURES (3)
Principles of Rock deformation, deformation mechanics, primary structure folding foliation,
lineation, intrusive and extrusive structures, faults and joints, and deformation of lithosphere.
geostatistics, estimation, global estimation, point estimation.

MinE 5577 ADVANCE GEOSTATISTICS (3)
Modeling the sample variograms, ordinary kriging, block kriging, search strategy, cross validation, co-kriging, change of support, assessing uncertainty, practical aspects of geostatistical modeling in mining.

MinE 5580 GEOCHEMISTRY (3)
Structure of the Earth - crust, mantle, core, mass moment of interia seismic evidence. Temperature and pressure distribution.
Geochemistry: Main Chemical Elements - Relative abundances of some elements and types of compounds. Densities and compositions of different layers. Chemistry of igneous, sedimentary and metamorphic rocks. Structural Aspects silicate chemistry, bond angles, coordination of ions, ion replacement. Some important series.
Geochemistry of Surface and Sub-Surface Water: Effects of Water-hydrothermal processes, supercritical water, crystallization. Effect of water on melting points. Thermodynamics - silicate systems, phase changes; Three-component diagrams, composition of layers in the mantle, at high pressures, Oxidation and Reduction - Composition of atmosphere, changes, effects on iron in different minerals, Electrical conduction by silicates. Less abundant elements Segregation in the crust. Availability of useful elements, formation of ore deposits.

MinE 5581 DIMENSION STONE MINING (3)
Concept, types, and uses of dimension stones, index and geochemical properties, reserves and production of dimension stones, quarrying techniques, conventional methods, advanced methods, comparison of various methods, processing methods, marketing trends, environmental impacts, equipment selection, case studies.

MinE 5582 MINE ENVIRONMENTAL CONTROL FOR BLASTING (3)
Review of blasting theory, controlled blasting techniques, ground vibrations and control, blasting seismograph operation, geological effects on blasting, air blast and control, fly rock control, blasting security, toxicity and pollution control.

MinE 5590 SPECIAL STUDIES (3)
Individual studies on selected topics.

MinE 5599 MASTER'S THESIS (6)
MinE 6599 Ph.D. THESIS (1-9)
The field of Computer Systems Engineering has emerged as one of the principal areas of study throughout the world, making the subject area critical in the development of new computer systems, devices and products. The task of this branch of engineering is to solve practical engineering problems by creating computer based systems, in particular, systems that have a computer embedded in a larger system. It includes a diverse set of engineering skills in the areas such as sensing real world quantities, signal conditioning for sensors, digitizing signals, decision making in hardware and software, software engineering, control systems, robotics, electronic devices for actuators, actuator design; any system that must sense, make decisions, and act in the real world.

Increasingly, the computers are used in real time control applications, such as appliances, automobiles, industrial processes, alarm systems, communication systems, robotics and automation. The research in computer systems has its applications in a broad range of situations, such as consumer and medical electronics, custom electronic design, digital communication systems, computer networks, wireless networks, transport systems, electricity generating stations, automation, and heavy machinery.

At postgraduate level, the department offers M.Sc. and Ph.D. programs in computer systems engineering. The postgraduate programs provide knowledge and research skills in a wide range of subjects related to computer systems engineering particularly signal processing, system design, artificial intelligence, robotics, computer vision, computational bioinformatics and networks.
Department of Computer Systems Engineering

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RESEARCH PROJECTS AND FACILITIES
The department has highly qualified faculty, which is actively participating in the university’s research activities. Research activities are carried out mostly in the field of computer networks, digital signal processing, control systems, artificial intelligence and neural networks, embedded systems, advance digital design, computational bioinformatics and computer architecture.
For this purpose the department boosts well equipped laboratories as detailed below:
1. Three state of the art computing laboratories
2. Digital/Electronics Laboratory
3. Microprocessor Laboratory
4. DSP/Advance Digital Design Laboratory
5. Project Laboratory
6. Embedded Networks Laboratory

INTERACTION WITH INDUSTRY
The department maintains regular interaction with the public and private sector organizations. Courses in latest engineering techniques of interest to the industry are offered on regular bases.
LIST OF APPROVED COURSES

Note: The courses offered in a semester will be announced by the department at the time of registration of students.

CSE5601 Advanced Computer Networks (3)
This course covers a set of advanced topics in computer networks. The goals of the course are to develop a strong understanding of network from the physical to application layer. The focus is on principles, architectures, and protocols used in modern networked systems, wireless and mobile networks. Topics include Protocol layering, Internet protocol, Transmission Control Protocol, routing algorithms and application specific protocols. It also examines the fundamentals of mobile network architecture, mobility issues in networking, routing schemes for mobile and nomadic hosts, including Mobile IP, Mobile Ad Hoc Network (MANET) protocols, DHCP and IPv6. Unix Programming Environment for Socket Programming including UDP, TCP, Routing and Raw Sockets is also discussed in detail.

Recommended Books:

CSE5602 Integrated Services Over Packet Networks (3)
Introduction to packet networks, from physical layer up to the transport layer, specifically focusing on Internet Protocol. Both real-time and non-real-time applications and transport mechanisms shall be discussed. Signaling aspects, signaling in packet networks, traffic control and QoS, voice over IP and video over IP.

Recommended Books:
1. Denniel Collins, “Carrier Grade Voice over IP”.

CSE5603 Cryptography and Network Security (3)
Introduction to computer security, Classical Cryptography, Block ciphers and Symmetric (secret key) cryptography, Asymmetric (public key) cryptography, Key exchange protocols, Certificates, Message authentication and Hash functions, Hash algorithms, Digital signatures and authentication protocols, Authentication applications, Electronic mail security, IP security and web security, Intruders, Intruding techniques, Intrusion detection and password management, Malicious software, Firewalls.
CSE5604  Network Modeling and Simulation (3)

Recommended Books:

CSE5605  Mobile Communication Systems (3)
This course is designed to prepare students for engineering work in the industry and for the advanced graduate work in the area of mobile communication. The course covers concepts and useful tools for design and performance analysis of wireless communication systems. To achieve the goal the topics that will be covered include: Introduction to wireless communication systems and networks, Cellular Wireless Networks and System Principles, Antennas and radio Propagation, Signal Encoding and Modulation techniques, 1G, 2G and 3G wireless systems (AMPS, GSM, GPRS, EDGE, etc), the UMTS network and radio access technology Wireless LANs, IEEE802.1x.

Recommended Books:
1. Anurag Kumar, D. Manjunath and Joy Kuri, “Communication Networking”.

CSE5606  Wireless Networks (3)
Wireless channels and transmission fundamentals. MAC and link layer protocols for wireless networks. Wireless LANs; IEEE 802.11, HIPERLAN and Bluetooth. Wireless ATM. Mobile IP and TCP. Ad hoc networks. Mobility support; World Wide Web and WAP.
**CSE5607 Wireless Sensor Networks (3)**  
Application scenarios, design of sensor nodes, architecture of sensor networks, challenges in sensor networks, energy-aware MAC & link layer, naming & addressing, clock synchronization, localization and positioning, topology control & routing protocols.

**CSE5608 Peer to Peer Networked Systems (3)**  
Peer-to-Peer systems and applications, basics of Peer-to-Peer networking: motivation, characteristics, challenges, goals, unstructured Peer-to-Peer systems, e.g. Gnutella, FreeNet, etc., structured Peer-to-Peer systems, mainly the concept of distributed hash tables (Chord, CAN, Pastry), Peer-to-Peer applications, like end-system-based multicast, distributed file systems, instant messaging, P2P-VoIP, etc.

**CSE5609 Delay Tolerant Networks (3)**  
Delay Tolerant Networks (DTN) routing, energy-aware routing protocol for DTNs, a routing-compatible credit-based incentive scheme, R-P2P: a data-centric middleware for delay tolerant applications, mobile peer-to-peer systems over DTNs, delay-tolerant monitoring of mobility-assisted WSN, message dissemination in vehicular networks, DTN protocols for space communications, DTN for satellite communications.

**CSE5610 Cloud Computing (3)**  
Concept and motivation, virtualization technologies, architectures, networking, storage and file systems, programming models, application development.

**CSE5611 Stochastic Processes (3)**  
This course is designed to make the student to understand the fundamentals of the tools of probabilistic modeling and random processes useful for communication, control and signal processing. Differences between continuous state continuous time processes, continuous state discrete time processes, discrete state discrete time processes, discrete state continuous time processes, Gaussian processes, Markov processes, Bernoulli processes, Poison processes, Random Walk and Weiner processes, Complex random processes, mean correlation and covariance functions, stationarity, wide sense stationarity, strict sense stationarity, ergodicity, properties of autocorrelation function, signal pulses with random amplitudes and arrival times, periodic random processes, cyclostationary processes and power spectral density.

**Recommended Books:**

CSE5612  Advanced Digital Signal Processing (3)

This course provides an in depth knowledge of

CSE5618 Multimedia Communications (3)

Due to continuous advancements in the capabilities of internet its use is gradually further increasing. With the growth of the Internet, new applications and services are immerging which combines a verity of services, such as video, audio and data traffic to provide heterogeneous facilities. This course provides an introduction to the technological issues related to the transport of multimedia traffic over the Internet. This course also introduces fundamental technologies for multimedia communications and networking.

The course will aim to introduce the concepts, technologies, issues, protocols and standards related to the transport of multimedia traffic over the Internet or similar network sub-system.

Recommended Books:


CSE5619 Code Optimization for DSP Applications

The course will look at different practical techniques that are employed for DSP (Image and Video) code optimization. As DSP applications are usually very computationally intensive, thus to run them in real-time, we have to employ very aggressive code optimization techniques. For example Loop Unrolling, Efficient Memory Accesses and the use of DSP processor specific instructions (intrinsic).

The course will be a practical hands-on course in which the students will take well known DSP (Image and Video) algorithms such as DFT, DCT, Motion Estimation, H.264/VC-1 Deblocking Filters, H.264/VC-1 Arithmetic VLC coding, H.264/VC-1 Intra Prediction and implement them in C Language on DSP processors. The aim of the implementations will be to optimize the code as much as possible so that the code runs as fast as possible.

Recommended Reading:


CSE5620 Pattern Recognition (3)

This course covers the fundamentals of Pattern Classification. The topics covered includes Baye’s classification rule, minimum error rate classifier, discriminant functions, decision boundaries, univariate and multivariate probability distribution
modifying large software systems, specification and Level Parallelism, Thread level parallelism, documentation. Functions oriented and object Transformations that enhance data locality in cache oriented modular approach designing for reuse and and main memories, Programming languages maintainability, specification and documentation. features, Principles and practice of optimizing and Verification and validation. Cost and quality metrics parallelizing compilers, Data dependence analysis, and estimation. Project team organization and C o n c u r re n c y a n a l y s i s , S h a r e d m e m o r y, management Multiprocessors, message passing architectures.

Recommended Books: Recommended Book:

CSE5631 Advanced Digital Design (3) Number Systems, Logic Design and VLSI, Fixed-Point Addition, Subtraction, Multiplication and Division,
CSE5629 Advanced Computer Architecture (3) Decimal Arithmetic, Floating-Point Arithmetic, Review of technology trends: Cost, Performance High-Throughput Arithmetic, ... Pipelining, VLIW and superscalar Assignments using logic synthesis tools. Processor, Data Path and Controller Design,

Recommended Books:

CSE5632 Advanced Embedded System Design (3) CSE5630 Parallel Processing (3) Includes topics related to Embedded System Introduction to Parallel Processing, Instruction
modifying large software systems, specification and documentation. Functions oriented and object-oriented modular approach designing for reuse and maintainability, specification and documentation. Verification and validation. Cost and quality metrics and estimation. Project team organization and management

Recommended Books:
1. Ian Sommerville, Software Engineering (International Computer Science Series), Addison-Wesley.

CSE5629 Advanced Computer Architecture (3)

Recommended Books:

CSE5630 Parallel Processing (3)
Introduction to Parallel Processing, Instruction Level Parallelism, Thread level parallelism, Transformations that enhance data locality in cache and main memories, Programming languages features, Principles and practice of optimizing and parallelizing compilers, Data dependence analysis, Concurrency analysis, Shared memory, Multiprocessors, message passing architectures.

Recommended Books:

CSE5631 Advanced Digital Design (3)
Number Systems, Logic Design and VLSI, Fixed-Point Addition, Subtraction, Multiplication and Division, Decimal Arithmetic, Floating-Point Arithmetic, High-Throughput Arithmetic, Low-Power Arithmetic, Fault-Tolerant Arithmetic, Structure of Sequential Machines, Asynchronous Circuit Design, Assignments using logic synthesis tools.

Recommended Books:

CSE5632 Advanced Embedded System Design (3)
Includes topics related to Embedded System
Designing, applications based on Microcontrollers/ARM etc, System on Chip modeling and its

Recommended Books:
2. Peter Brass, Advanced Data Structures, Cambridge University Press.

CSE5640 Management Information System (3)

Recommended Books:

CSE5641 Engineering Project Management (3)
Course gives the student the necessary Knowledge to make a project proposal, plan, budget and schedule a project. Compare alternative projects. Analyze the risks and uncertainties of a project. It also requires the student to be able to proficiently use a project management tool such as Microsoft Project or Primavera.

Recommended Books:
1. Chalmers, A. F., “What is this Thing Called Science?”.


CSE5691 Tech. Report Writing & Research Methodology (3)
This course covers the basic introduction to modern approaches to science and particularly engineering. The student will get an insight into the history and philosophy of science and into how scientific methods are applied in the science of engineering. The goal is to enable the students to read contemporary scientific literature in the chosen field of specialization and distill the main ideas of a paper and to write these down in his/her own words. At the end of this course the student will have acquired knowledge of how to conduct a research project and of how to write scientific texts. Content covered includes,

- The principles of theory of science.
- Different research areas and their application areas in engineering science
- Methods for information seeking.
- Reviewing/ assessing of scientific publications
- To work in a group and group organizational control tools
- Scientific writing
- How to write and organize a scientific publication.
- Research ethics/morals.
- Presentation of/acting as opponent of research results

Recommended Books:
1. Chalmers, A. F., “What is this Thing Called Science?”.

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Computer Systems Engineering

CSE5690 Special Topics (3)
CSE5699 Master's Thesis (6)
Chemical Engineering is the branch of engineering, which blends the basic sciences with engineering knowledge and design fundamentals to develop, design, analyze and engineer the industrial processes and plants that turn raw materials into valuable products. These processes must be accomplished in a competitive economy and environmentally safe manner to create products, which are useful and essential to the modern world. Chemical Engineering science is based upon the fundamentals of mass, momentum, and heat transfer, thermodynamics and chemical kinetics. Chemical engineers are extremely versatile and able to handle a wide range of technical problems. They are familiar with the necessary skills that encompass detailed understanding of all aspects of design, testing, scale-up, operation, control, and optimization of different unit operations. They are familiar with many industries such as fuels and petrochemicals, plastics, fibers, paper, foods, building materials, water desalination and pharmaceuticals. A chemical engineering degree is also good preparation for careers in pollution prevention and waste minimization.
Chemical Engineering is the branch of engineering, which blends the basic sciences with engineering knowledge and design fundamentals to develop, design, analyze and engineer the industrial processes and plants that turn raw materials into valuable products. These processes must be accomplished in a competitive economy and environmentally safe manner to create products, which are useful and essential to the modern world. Chemical Engineering science is based upon the fundamentals of mass, momentum, and heat transfer, thermodynamics and chemical kinetics. Chemical engineers are extremely versatile and able to handle a wide range of technical problems. They are familiar with the necessary skills that encompass detailed understanding of all aspects of design, testing, scale-up, operation, control, and optimization of different unit operations. They are familiar with many industries such as fuels and petrochemicals, plastics, fibers, paper, foods, building materials, water desalination and pharmaceuticals. A chemical engineering degree is also good preparation for careers in pollution prevention and waste minimization.
RESEARCH PROJECTS AND FACILITIES
The mission of the Department of Chemical Engineering at University of Engineering & Technology, Peshawar is to be a national leader in chemical engineering research and to achieve excellence in teaching. Chemical Engineering Department offers state of the art equipment and high-tech laboratories to facilitate the post graduate students in research projects and to acquire the understanding of various chemical processes by providing small-scale units and simulated industrial work environment. Chemical Engineering Department helps students equip with practical knowledge and trouble shooting through its various computer-controlled up-to-date laboratories such as of Chemical Process Technology, Chemical Reaction Engineering, Chemistry, Environmental Engineering, Fluid Flow, Fuel and Combustion, Heat Transfer, Instrumentation and Control, Mass Transfer, Particle Technology, SHMT, Thermodynamics.

AREA OF SPECIALIZATION
M.Sc Advanced Chemical Engineering (ACE)
This programme is aimed to enhance the technical and communication skills of the chemical engineers. It is built around a core of six chemical engineering courses including advanced mass transfer, advanced chemical reaction engineering, advanced heat transfer and advanced chemical engineering thermodynamics. Electives in other areas to broaden the students’ exposure are also offered. Moreover, it includes independent research, and defence of a thesis based on this research. The results of the thesis must be publishable in a technical refereed journal. The programme will prepare chemical engineers for careers in teaching research and development, and management in academia, government, and industry. This programme provides a basis for continued study leading to the Ph.D. degree.

Ph.D in Chemical Engineering
The Department of Chemical Engineering offers robust doctoral programme in Chemical Engineering. The department has five (5) faculty members with Ph.D degrees from technically advanced countries. All the doctoral faculty are on “HEC approved Supervisor” List. The interested candidates are offered the admission based on expertise of respective faculty member’s following area of specialization:

- Membrane Separation Processes
- Bio-Engineering
- Process intensification
- Computational Fluid Dynamics
- Process Modeling and Simulation
- Resource Conservation and Recycling

LIST OF APPROVED COURSES
A. Compulsory courses
ChE 5615 Advanced Mass Transfer
ChE 5616 Advanced Chemical Reaction Engineering
### Chemical Engineering

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tbody>
<tr>
<td>ChE 5621</td>
<td>Process Dynamics and Control</td>
</tr>
<tr>
<td>ChE 5618</td>
<td>Process Simulation and Optimization</td>
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<tr>
<td>ChE 5619</td>
<td>Advanced Heat Transfer</td>
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<tr>
<td>ChE 5620</td>
<td>Advanced Chemical Engineering Thermodynamics</td>
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<tr>
<td>ChE 5607</td>
<td>Mathematical Methods in Chemical Engineering</td>
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<tr>
<td>ChE 5626</td>
<td>Advanced Transport Phenomena</td>
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<td>ChE 5623</td>
<td>Computational Fluid Dynamics</td>
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<td>ChE 5624</td>
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<td>ChE 5627</td>
<td>Technical Report Writing &amp; Research Methodology</td>
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<tr>
<td>ChE 5698</td>
<td>Special Topics related to Chemical Engineering</td>
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<tr>
<td>ChE 5699</td>
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<td>ChE 6699</td>
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**B. Elective Courses**

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<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tr>
<td>ChE 5601</td>
<td>Membrane separation processes</td>
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<td>ChE 5602</td>
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<td>ChE 5603</td>
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<tr>
<td>ChE 5604</td>
<td>Experimental Design and analysis</td>
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<td>ChE 5606</td>
<td>Advanced Chemical Process Analysis and Design</td>
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<tr>
<td>ChE 5608</td>
<td>Polymer Engineering</td>
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<tr>
<td>ChE 5609</td>
<td>Application of Corrosion Engineering in Process Industries</td>
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<tr>
<td>ChE 5610</td>
<td>Heat Recovery System Design</td>
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<tr>
<td>ChE 5611</td>
<td>Separation System Design</td>
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<td>ChE 5612</td>
<td>Management in Technical Organizations</td>
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<td>ChE 5613</td>
<td>Industrial Waste Management</td>
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<tr>
<td>ChE 5614</td>
<td>Occupational Health and Safety in Process Industries</td>
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**ChE 5615 ADVANCED MASS TRANSFER (3)**

Advanced treatment of theories of mass transfer; film theory; penetration theory; convective mass transfer, concentration boundary layer, turbulent transport and other mass transfer models, mass transfer accompanied by chemical reactions of various orders both reversible and irreversible; enhancement factor; design equations. Application of mass transfer to selected industrial separation processes.

**ChE 5616 ADVANCED CHEMICAL REACTION ENGINEERING (3)**

Review of fundamental principles; order of reactions 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 Engineering

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.

**ChE 5618 PROCESS SIMULATION AND OPTIMIZATION**


**ChE 5619 ADVANCED HEAT TRANSFER (3)**

Heat conduction equation; analytical methods in conduction heat transfer; Bessel equations; the methods of separation of variables; Laplace transforms; finite differences and finite elements. Methods of determination of the heat transfer coefficient, heat transfer in natural convection; forced convection; similarity theory; correlation of heat transfer coefficients; and heat transfer in boiling & condensation processes. Introduction to heat exchanger design. Radiation heat transfer; radioactive properties of real materials; radiation exchange between back surfaces and between gray surfaces.

**ChE 5620 ADVANCED CHEMICAL ENGINEERING THERMODYNAMICS (3)**

Laws of thermodynamics; unsteady state processes. Introduction to molecular thermodynamics; equation for activity coefficients and thermodynamics property estimation. Determination of the multicomponent phase equilibrium.

**ChE 5601 MEMBRANE SEPARATION PROCESSES (3)**

Membrane structure and function; production of membrane; characterization. Selection and use of membrane system; application for separations in process industries.

**ChE 5602 MULTI-PHASE FLOW (3)**

Two-phase flow in chemical engineering systems; Definitions and averaging of two phase flows; Flow regimes and transitions; Two phase model and pressure drop; Pool boiling models; Choked two phase flow; Flow boiling; Condensation; Two-phase flow instability; Two-Component, Gas-Liquid Flow; Process Steam Line Design; Measurement of Two-Phase Flows.
ChE 5604 EXPERIMENTAL DESIGN AND ANALYSIS (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.

ChE 5607 MATHEMATICAL METHODS IN CHEMICAL ENGINEERING (3)
Formulation of differential equations modeling physical phenomena in chemical engineering. solutions of sets of ordinary differential equation; solution of partial differential equations using methods of infinite series and separation of variable; Bessel functions and Legendre polynomial; vector and tensor analysis; complex variables; analytic functions; harmonic functions; Cauchy's integral theorem; Laurent's expansion; and theory of residues; calculus of variation, analysis of multi-stage processes such as distillations towers, absorber and so on.

ChE 5603 BIOCHEMICAL ENGINEERING (3)
Biochemical fundamentals; Analysis of microbial kinetics for bioreactor design; Design and Analysis of batch, continuous and multiphase bioreactors; advanced control strategies of bioreactors. Enzyme and microbial kinetics; various fomenters for enzyme and pure cultures; Sterilization; Bioprocess economics; Recent developments on biotechnology.

ChE 5608 POLYMER ENGINEERING (3)
Polymer and their application as engineering materials; structure and properties of polymers; crystalline; semi-crystalline and amorphous polymer. Mechanisms of polymerization reactions and practical production of polymers with desired properties. Mechanical properties of polymers; theory of rubber elasticity; yielding of polymers; polymer rheology; viscoelastic of polymers and viscoelastic models and polymer composites.
ChE 5609 APPLICATION OF CORROSION ENGINEERING IN PROCESS INDUSTRIES (3)
Corrosion principles and applications, forms of corrosion, Types of Corrosive Environments, Corrosion processes kinetics; potential-current diagrams, corrosion processes control. Overview of the properties of commonly used engineering materials and their resistance to corrosion. Methods of corrosion control.

ChE 5621 PROCESS DYNAMICS AND CONTROL (3)
Pre requisite an undergraduate course in process control.

ChE 5623 COMPUTATIONAL FLUID DYNAMICS
General Differential Equations; Numerical solutions 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.

ChE 5624 CLEAN COAL TECHNOLOGY

ChE 5626 ADVANCED TRANSPORT PHENOMENA (3)
Fundamentals of momentum; energy and mass transport; determination of transport properties; conservation of mass momentum and energy in laminar flow and turbulent flow in microscopic approach; equation of change for multi
component systems; dimensional analysis equation of change; simultaneous heat; mass; momentum transfer; laminar and turbulent boundary layer theory.

ChE 5610 DESIGN OF HEAT RECOVERY SYSTEMS (3)

ChE 5611 SEPARATION SYSTEM DESIGN (3)
Introduction to separation system design, Choice of separation technology, Separation of heterogeneous and homogeneous mixtures, Distillation system design, Physical and thermodynamic property modeling, Retrofit distillation design, Distillation sequencing
Azeotropic distillation design, Absorption, Adsorption, Extraction, Membrane separation, Crystallization, Evaporation.

ChE 5612 MANAGEMENT IN TECHNICAL ORGANIZATIONS (3)

ChE 5613 INDUSTRIAL WASTE MANAGEMENT (3)

ChE 5614 OCCUPATIONAL HEALTH & SAFETY IN PROCESS INDUSTRIES (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 basic
principles of accident prevention in industries, Risk analysis, safety performance measurement in industries, Strategies for control of occupational safety and health hazards in process industries.

**ChE 5627 TECHNICAL REPORT WRITING & RESEARCH METHODOLOGY (3)**
Basics of technical writing process, Technical writing techniques and applications, Definition and basics of research, research purpose, Design of research methods, Identification of research problem, literature review, Selection of data collection techniques, selection of representative sample, writing of research proposals, Data collection and analysis techniques, Limitations and significance of research techniques, Quantitative and qualitative research procedures, Writing of research reports, Presentation skills, oral presentations.

**ChE 5698 SPECIAL TOPICS RELATED TO CHEMICAL ENGINEERING (3)**

**ChE 5699 MASTER’S THESIS (6)**

**ChE 6699 Ph.D. THESIS (1 - 9)**
Department of Computer Science & Information Technology

The Department of Computer Science & Information Technology (CS&IT) offers graduate courses leading to the award of Master of Science (MS) and Ph. D in Computer Science. The Department owes its emergence to the relentlessly growing demand of professionals with expertise in areas of computers, communications and information processing technologies. The Department has strong collaborations with other engineering departments of the University. The Department is equipped with laboratories having state-of-the-art computer systems running a wide range of applications and specialized software supporting the courses. The Department provides a stimulating and challenging environment essential for high quality education. Students receive training in design, development and application of computer science and information processing techniques. The graduates of this Department will be able to meet the highest standards for leadership in computer science and Information Technology and fulfill the demands of the huge IT market of the 21st century.

Mission

The mission of the CS & IT Department is:

- To provide undergraduate/graduate education to the community in computing discipline and to create and disseminate computing knowledge/technology.
- To achieve excellence in research by solving problems of real-world complexity with the potential for significant long-term impact on the fields of computer science and multidisciplinary computing.
- To achieve excellence in education, providing the nation with computer scientists having extensive knowledge allowing them to adapt to a rapidly changing technology and providing industry, academic and government sectors with the next generation of leaders.

ASSISTANT TO DEAN
Dr. Sadeeq Jan Ph.D. (Luxembourg)

Assistant Professors
Dr. Sadeeq Jan Ph.D. (Luxembourg)
Dr. Iftikhar Ahmad Ph.D. (Germany)
Dr. Suhail Yousaf Ph.D. (The Netherlands)
Dr. Kamran Ghani Ph.D. (UK)
Dr. Wajeeha Khalil Ph.D. (Austria)
Dr. Izhar Ullah Ph.D (UK)
Mr. Laeeq Ahmed MS (CS) (UK)
Mr. Ismat Ullah Khan M.Sc. (CS) (Pak)

Lecturers
Miss. Zakira Inayat Ph.D. (Malaysia)
Mr. Dilawar Khan MS (CS) (Pak)
Mr. Imran Rasheed MS (CS) (Pak)
Mr. Sadiq-ur-Rehman MS (CS) (Pak)
Mr. Amir Taj MS (CS) (UK)
Mr. M. Imran Khan Khalil MS (IT) (Pak)
Miss. Aisha Javed MIT (Pak)
Mr. Inayat Ullah MS (CS) (Pak)
Engr. Mujtaba Hassan M.Sc (CE) (Pak)
Engr. Alauddin M.Sc (CE) (Pak)
Computer Laboratories
The Department has a number of state-of-the-art computer laboratories equipped with latest computers having all the required development software and tools. These laboratories have also been connected with the Digital Resource Library of the Higher Education Commission (HEC) to provide latest resources and information to students as well as to faculty members of the Department.

List of Approved Courses

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<td>Advanced Theory of Computation (Core Course)</td>
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<tr>
<td>CS-5501</td>
<td>Advanced Algorithm Analysis (Core Course)</td>
<td>3</td>
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<tr>
<td>CS-5504</td>
<td>Research Methodology (Core Course)</td>
<td>3</td>
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**CS-5500 Advanced Theory of Computation (Core Course) (3)**
This course will cover: Introduction, Finite Automata, Deterministic Finite Automata, Nondeterministic Finite Automata, Regular Expressions, Regular and non-regular Languages, Context-Free Grammars, Pushdown Automata, Properties of Context-Free Languages, Turing Machines, The Pumping Lemma for regular languages, Proving non-regularity using the Pumping Lemma, Proving non-regularity using reduction, Self-reference and incompleteness, Undecidability of the Halting problem, Diagonalization and reduction, Decidability, undecidability, recognizability, Enumerability, Post Correspondence Problem (PCP), Modified Post Correspondence Problem (MPCP), Undecidability of PCP and MPCP, Rice's theorem.

**CS-5501 Advanced Algorithm Analysis (Core Course) (3)**
This course will cover: Introduction to algorithm analysis including formal techniques and the underlying mathematical theory, Growth of Functions and asymptotic analysis of upper and average complexity bounds using big-O, little-o, and theta notation, Fundamental algorithmic strategies including brute-force, greedy, divide-and-conquer, backtracking, branch-and-bound, pattern matching, and numerical approximations, Standard graph and tree algorithms, Standard complexity classes, time and space tradeoffs in algorithms, using recurrence relations to analyze recursive algorithms, non-computable functions, the halting problem, and the implications of non-computability, NP-completeness, Search Techniques, Randomized Algorithms, Heuristic and Approximation Algorithms.

**CS-5504 Research Methodology (Core Course) (3)**
This course will cover: Information Skills: Search and Critical Evaluation - To know skills to search, retrieve, and critically evaluate information, Research Ethics and Plagiarism - To identify the role and responsibilities of scientists, examine the ethical questions, and to introduce plagiarism, Statistics in Research - To examine fundamental elements of statistics and show their importance in making inferences from data, Research Methods I - The use of experimental methods to address research questions, and quantitative and qualitative methods to explore and investigate a hypothesis based on a given set of data, Research Methods II - The use of experimental methods to address research questions, and quantitative and qualitative methods to explore and investigate a hypothesis based on a given set of data, Latex I - A introduction to Latex (a document preparation system) and demonstrating its abilities to prepare both an article and a presentation, Latex II - A introduction to Latex (a document preparation system) and demonstrating its abilities to prepare both an article and a presentation. Academic Writing - To examine the context and key features of academic writing and techniques with practical exercises to improve writing, Critical Review of research papers - To develop practical experience to critically reviewing research papers and drawing conclusion from the arguments and data being presented, Data Presentation - To learn time saving tools and techniques to present your arguments and data being presented, Data Presentation - numerical approximations, Standard graph and tree
CS-5530 Requirement Engineering (3)
This course will cover: Definition of requirements engineering and role in system development, Fundamental concepts and activities of requirements engineering, Information elicitation techniques, Modeling scenarios, Fundamentals of goal-oriented requirements engineering, Modeling behavioral goals, Modeling quality goals, Goal modeling heuristics, Object modeling for requirements engineering, Object modeling notations, Object modeling heuristics, Identifying objects from goals, Modeling use cases and state machines, Deriving operational requirements from goals, Requirements Specification, Requirements verification and validation, Management of inconsistency and conflict, requirements engineering risks, the role of quality goals in the requirements selection process, Techniques for requirements evaluation, selection and prioritization; Requirements management; Requirements traceability and impact analysis.

CS-5531 Software System Architecture (3)
This course will cover: Definition and overview of software architecture, the architecture business cycle, Understanding and achieving quality attributes, Attribute-driven design, Documenting software architecture, Evaluating software architecture, Architecture reuse, Life-cycle view of architecture design and analysis methods, The QAW, a method for eliciting critical quality attributes, such as availability, performance, security, interoperability, and modifiability, Architecture Driven Design, Evaluating a software architecture (ATAM, CBAM, ARID), Principles of sound documentation, View types, styles, and views; Advanced concepts such as refinement, context diagrams, variability, software interfaces, and how to document interfaces; Documenting the behavior of software elements and software systems; Choosing relevant views; Building a documentation package.

CS-5532 Software Quality Assurance (3)
CS-5533 Software Project Management (3)

CS-5534 Software Measurement and Metrics (3)
This course will cover: Measurement theory (overview of software metrics, basics of measurement theory, goal-based framework for software measurement, empirical investigation in software engineering), Software product and process measurements (measuring internal product attributes: size and structure, measuring external product attributes: quality, measuring cost and effort, measuring software reliability, software test metrics, object-oriented metrics), Measurement management.

CS-5535 Software Configuration Management (3)
This course will cover: Introduction to software configuration management, Configuration management process model, configuration identification, configuration control, configuration status accounting, configuration verification and audit, configuration management and data management, configuration change management, configuration management and software engineering standards reference, configuration management automation.

CS-5536 Software Design Patterns (3)
This course will cover: What is a design pattern, history, Creational patterns (Abstract Factory, Builder, Factory method, Lazy initialization, multiton, object pool, prototype, singleton), Structural patterns (Adaptor, bridge, composite, decorator, façade, flyweight, proxy), Behavioral Patterns (blackboard, chain of responsibility, command, interpreter, iterator, mediator, momento, null object, observer or publish subscribe, state, strategy, template method, visitor), Concurrency patterns.

CS-5537 Formal Methods (3)
This course will cover: the concepts of formal methods more specifically formal specifications, underlying mathematical foundation of formal methods as well languages or language constructs for developing a software systems using formal methods. Course outline will be furnished by instructor as different options are available.

CS-5538 Software Engineering Ontologies (3)

CS-5539 Semantic Web Enabled Software Engineering (3)
This course will cover: Semantic web introduction, Metadata, metadata standards, XML+metadata specification, RDF and metadata processing, OWL. Semantic application. Classification and semantic metadata extraction techniques. Current problems and research.
possibilities.

**CS-5540 Model Driven Software Development (3)**

This course will cover: Models, Modeling, and Model-Driven Architecture (MDA). Basic Ideas and terminology, MDSD concept and terminology, Architecture centric MDSD, Generative Programming, Data driven development, Agile software development, Metamodelling, MDSD-capable target architecture, Building domain architectures, code generation techniques, Model Transformation, MDA standards, testing, versioning. Current research topics as decided by instructor.

**CS-5541 Web Engineering (3)**

This course will cover: Web engineering introduction, Requirements engineering for Web applications, design methods and technologies, interface design, usability of web applications, accessibility, testing, metrics, operation and maintenance of Web applications, security, and project management. Specific technologies covered in this course include client-side (XHTML, JavaScript, and CSS) and server-side (PHP, JSP and servlets). Data driven technologies using MySQL.

**CS-5542 Software Testing (3)**


**CS-5543 Advanced Topics in Software Engg; (3)**

The contents of this course will be developed by the instructor based on the emerging topics of interest and active research in the said area.

**CS-5550 Computer Security (3)**


CS-5551

Advanced Network Security (3)


CS-5552

Security Management (3)

This course will cover: Assessing and managing security risks, Developing security policies and plans, Evaluating, validating and certifying the security of IT operations and systems, User authentication and privilege management, Ongoing security management and governance, Information Security Management Systems (ISMS) and International standards and requirements, including ISO/IEC27001: Information Security, COBIT and Sarbanes-Oxley. Risk assessment, risk valuation, risk treatment, residual risk, Managing for changes in technologies, environments and business needs, Social engineering (attack, techniques and defences).

CS-5553

Security in Mobile and Wireless Networks (3)

This course will cover: Introduction to wireless networks security, Analysis of threats and application requirements, Wireless networks security components, Security services in wireless and mobile networks: authentication, authorization, data confidentiality, data integrity and access control, Security infrastructure for wireless mobile networks: keys and certificate management, Secure group
Department of Computer Science & Information Technology

**CS-5551 Advanced Network Security (3)**


**CS-5554 Applied Cryptography (3)**


**CS-5555 Ethical Hacking (3)**

Methodologies, List of Penetration Testing Steps, Overview of Pen-Test Legal Framework. Automated Penetration Testing Tools

**CS-5556 Software Engg; & Security Architecture (3)**

This course will cover: known software vulnerabilities, different stages of the software development cycle to measures that can suitably alleviate software vulnerabilities. Assurance criteria evaluation methods are primarily represented by The Common Criteria. In order to gain a broad understanding of the method it is presented through several complementary perspectives. Software protection techniques, Software vulnerabilities and exploits, Buffer overflows, format strings vulnerabilities, Web application security (SQL injection, Cross-Site-Scripting, path traversal), Semantic web security.

**CS-5557 Database Security (3)**

This course will cover: Database Implementation, Database Security Issues, Access Control and Encryption, Access control mechanisms, Access hierarchies, Access control lists (ACLs), Capabilities. Access control techniques, Discretionary access control (DAC), Mandatory access control (MAC), Lattice-based access control (LBAC), Role-based access control (RBAC), Information flow controls, Bell-LaPadula model, Biba integrity model, Clark-Wilson model, Chinese Wall model, Database security, Statistical database model, Inference control mechanisms, Methods of attack, Mechanisms that restrict statistics. Mechanisms that add noise, Security in object-oriented database systems.

**CS-5558 Digital Forensics (3)**


**CS-5559 Theory of Information (3)**

This course will cover: Probability Theory, Random Processes, Information Theory and Measurement, Introduction, Uncertainty, Information, and Entropy, Joint and conditional entropy, Source-Coding Theorem, Data Compaction, Huffman Coding, Lempel-Ziv Coding, Discrete Memoryless Channels (DMC), Mutual Information, Channel Capacity, memory-less symmetric channels, erasure channels, Channel Coding Theorem, Information Capacity Theorem.

**CS-5560 Advanced Topics in Information & Comm. Security (3)**

The contents of this course will be developed by the instructor based on the emerging topics of interest and active research in the said area.

**CS-5570 Parallel Processing (3)**

This course will cover: Introduction to Parallel Processing, Introduction to Parallel Algorithms and its complexity, Parallel Processing architectures, SIMD and MIMD architectures, Shared memory and Distributed memory based architectures, Interconnect networks, Parallel Algorithms design strategies and development, Performance and reliability of Parallel Processing, Applications of Parallel Processing: Distributed Systems, Clusters and Grids, Mapping of sequential programs to parallel architectures, Data dependencies and parallelism,
Parallel Programming concepts, Parallel Languages.

**CS-5571 Distributed Systems**  (3)
This course will cover: architectures, processes, communication, naming, coordination, consistency and replication, fault tolerance, security.

**CS-5572 Cloud Computing**  (3)
This course will cover: Introduction to Clouds, Evolution, Emerging Technologies Hype Cycle, Characteristics, Multiple Cloud Environments, Cloud Deployment Models/Types, Private, Public, Community, Hybrid, Cloud Owner Classification, Public, Private, Architecture, Virtualization, Platform Virtualization, Resource Virtualization, Virtualization in Practice, Virtual Infrastructures, Virtual Machines, Virtual Switches, VMware VSphere, Vsphere Networking, Clusters, Monitoring Virtual Data Centers, High Availability and Fault Tolerance, Cloud Service Stack, Every-thing-as-a-Service(XaaS), Software-as-a-Service, Platform-as-a-Service, Infrastructure-as-a-Service, Utility Computing and Service Oriented Computing, Cloud Computing vs Grid Computing, Cloud Providers, Cloud Applications, Map Reduce Technique, Cloud Roadmap, Research Challenges, Adoption by H/W and S/W providers, Mile stones in Cloud Quick-start, Level 1: Web Architecture, Level 2: Self-Service Architecture, Level 3: Dynamic Infrastructure, Case Studies, Amazon Web Services, Amazon EC2, Hadoop, Microsoft’s Azure Infrastructure, Google's Big Table and DFS etc, Additional Topics

**CS-5573 Distributed Computing Paradigms**  (3)

**CS-5574 Virtual Organizations**  (3)
This course will cover: Characteristics, Types, Formal, Informal, Static, Dynamic, Permanent, Short termed, Profitable, Non-Profitable, Life Cycle, Creation, Maintenance, Management, Creation from Scratch, Pilot Approach, Application in different Domains (Weather Forecasting, Cancer Research, E-learning, Computational Science, Social Networks etc). Stakeholders, Trust Management, Business Models, Technological Aspects, Social Aspects, Platform Support, Case Studies: LEAD, N2Grid, etc, Additional Topics

**CS-5575 Grid Computing**  (3)
Performance Aspects on the Grid, Grid related issues, Knowledge Grid, Data Grid, Information Grid, Computational Grid, Grid related issues II, Grid portals, Quality of Service, Grid Economy, Collaboration on the Grid, Clouds, Additional Topics

**CS-5576 Advanced topics in Distributed Computing (3)**

The contents of this course will be developed by the instructor based on the emerging topics of interest and active research in the said area.

**CS5590 Advance Computer Networks (3)**


**CS-5591 Advanced Topics in Computer Networks (3)**


**CS-5522 Broadband and Satellite communication (3)**

This course will cover: History of satellite communications, Overview of the course, Satellite Systems, Orbits and constellations: GEO, MEO and LEO, Satellite space segment, Propagation and satellite links, Satellite Communications Techniques, Modulation and coding techniques, Digital modulation schemes, FEC and ARQ, Multiple Access, On-board processing techniques, Satellite Communications Systems and Applications. INTELSAT systems, VSAT networks, GPS, GEO, MEO and LEO mobile communications, Satellite Communication Payload, Earth Station Technology, Broadband and Multimedia Systems, Spaceway, Teledesic,

**CS-5593 Mobile and Pervasive Computing (3)**

This course will cover: Introduction and Background, Ubiquitous Data Access, Exploiting Virtual Machines, Resource-Driven Dynamic Adaptation, Sensing and Actuation, Mobile Hardware Technologies, Location and
Context Awareness, Security and Privacy, Design Methodologies and Infrastructure, End-to-End Application Considerations.

**CS-5594 Wireless Networks (3)**
This course will cover: Introduction to Wireless Communication System, First, second and third generation wireless networks (AMPS, GSM, GPRS... etc), Network layer issues and protocols – Mobile IP, addressing & routing for mobile systems, Wireless LANs: safety, security, cost. Bluetooth technology and applications, WSN (Wireless Sensor Network), RFID (Radio Frequency Identification), Transport and application layer protocols: WAP and beyond. Mobile agents, architectures and configurations. OS for mobile devices (such as Symbian, RIM, Android, Windows Phone, etc.). APIs for mobile devices and mobile communication. Software architectures and middle-ware for mobile enabled distributed systems. Security of mobile computing systems and applications.

**CS-5595 Network Administration (3)**
This course will cover the major utilities and concepts involved in using current network operating systems. This includes server organization, accounting, administrator duties, user addition, security, shared printing, rights, login scripts, menus and the most common network files and commands. It also covers the three most widely used network platforms: Novell NetWare, Microsoft Windows and Linux. Linux and its installation process are introduced in this course. Linux is a popular, widely used operating system. The class will explore Linux on a PC -- playing the role of a system administrator. Students will also learn how to run a Linux system using the command line and the GUI. They will learn how Linux boots up and shuts down and look at the X Windows system and how to configure and start it. Like other operating systems, Linux can use commands from a shell that is a blank screen with a cursor. The commands are similar in appearance to old-fashioned DOS commands and some programmers swear by this program.

**CS5596 Network Performance Evaluation (3)**
This is an advanced course in networks and protocols. Analytical, simulation and experimental methods should be used to evaluate and design networks and protocols. Investigate network management tools and techniques. Selection of techniques and metrics, types of workloads, monitors, capacity planning and benchmarking, queuing theory and simulation techniques will be studied.

**CS-5610 Advanced Databases (3)**
This course will cover: Advanced relational algebra and SQL, Set vs bag semantics, NULL values, Distinct operator, Semi join, left join, right join, SQL constraints and triggers, Data mining and OLAP operators: Group By, Roll Up, Cube, Pivot, Relationally complete SQL and temporary tables, Distributed databases, Horizontal/vertical fragmentation, Basic distributed query processing, Semi-join query processing, Schema integration, Advanced ER modeling: generalizations, n-ary relationships, look-across and look-here semantics, Alternatives for the translation of an ER schemas into a relational schema, Translation of a relational schema into ER schemas, Translation of between equivalent ER schemas, Schema conforming, merging and improvement, XML for semi-structured data, XML language and its tree representation, XML schema language,XPath/XQuery languages, Translation of an XML schema into a relational schema, Temporal Databases, Valid time and transaction time, Discrete bounded linear flow of time and the temporal structure, US logic and derived model operators, Representation of US logic as a temporal relational algebra,
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<tr>
<td>CS-5611</td>
<td>Multimedia Information Systems</td>
<td>(3)</td>
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<td></td>
<td>This course will cover: Definitions and components of Multimedia, Brain vs. Computer, Multimedia Applications, Multimedia Systems, Standards and Tools, Multimedia Delivery Methods, Multimedia on the Internet, Emerging Technologies, Multimedia Application Development, Sensations and Attention, Color and Constancy, Perceiving Objects, Space &amp; Movement, Sound, Language &amp; Thought, Interactivity, Learning</td>
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| CS-5612     | Distributed Database systems                     | (3)     |

| CS-5613     | Object oriented database systems                 | (3)     |
|             | This course will cover: The Object Oriented Databases, Object Oriented Databases - What and Why?, the Object Oriented Database Management Systems; Evolution of Object Oriented Concepts; Characteristics of an Object Oriented Data Model; Object Schema; Interobject Relationships; Late and Early Binding; Similarities and differences between Object Oriented Database Models and other Data models. Object Oriented DBMS Architectural Approaches The Extended Relational Model Approach; Semantic Database Approach; Object Oriented Programming Language Extension Approach; DBMS Generator Approach; the Object Definition Language and the Object Query Language. The Object Oriented DBMS Architectures; Performance Issues in Object Oriented DBMS; Application Selection forObject Oriented DBMS; the Database Design for an Object Relational DBMS. The Structured Typed and ADTs;Extending the ER Model; Storage and Access Methods; Query Processing; Query Optimization; Design and Architecture of POSTGRES; Distributed Computing in CORBA and EJB |

| CS-5614     | Data Mining                                      | (3)     |
|             | This course will cover: Introduction to data mining, Data preprocessing, Data mining knowledge representation, |
Data mining algorithms (prediction, classification), Decision trees, Bayesian, Back-propagation, Rule-based classification, kNN, Ensemble and Evaluating, Clustering, Partitioning, Hierarchical clustering, Density-based methods, Cluster evaluation, Association rule mining, Apriori, FP-growth

CS-5615 Data Warehousing (3)
This course will cover: The Compelling Need for data warehousing: Escalating Need for strategic information, failures of Past decision-support systems, operational versus decision-support systems, data warehousing – the only viable solution, data warehouse defined, Data warehouse – The building Blocks: Defining Features, data warehouses and data marts, overview of the components, metadata in the data warehouse Defining the business requirements: Dimensional analysis, information packages – a new concept, requirements gathering methods, requirements definition: scope and content, Data warehousing Architecture-source, integration layer, staging area, targets, analysis and reporting, Data modeling-introduction, phases of data modeling, principles of dimensional modeling, STAR schema, multidimensional modeling, Data modeling tools-Erwin, forward engineering, reverse engineering, update model, alter database, Issues in data warehouse planning, design, implementation, and administration are discussed in a seminar format. The role of data warehouse in supporting Decision Support Systems (DSS), OLAP in data warehouse.

CS-5616 Temporal and Spatial Databases (3)
This course will cover: Introduction and motivation, Time ontology, structure, and granularity, Temporal data models, Temporal relational algebras, Temporal query languages, Algorithms for temporal join and aggregation, Spatial databases and data models, Logical geographic data models for spatial databases, including vector and raster model, Physical data storage, data access methods, query processing and optimization, Design conceptual data models for spatial databases using a ER diagram approach, Process and retrieve geographic data from spatial databases using OGIS/SQL1999 interface and other specific interface (SDK) from database vendors.

CS-5617 Transaction Processing Systems (3)
This course will cover: Introduction and motivation, Serializability theory, conflict serializable, Examples and page model, concurrency control, index concurrency, recovery, crash recovery, distributed commit protocol, two phase commit, replication, Parallelism, distribution design, federated and multi-databases.

CS-5618 Digital Libraries (3)
This course will cover: Digital libraries – definitions and examples, History of digital libraries, Digital objects – multimedia and text, Collection development, Digitization, Harvesting, Digital markup, Knowledge representation, Metadata, Architectures and protocols, User behavior and interaction, Usability, DL services, Search engines, Digital reference., Recommender systems, Web publishing, Preservation, Sustainability, DL management, DL evaluation, Legal issues (such as copyright, cost and economic issues, Social issues, Future of DLs, Education for DLs, DL research initiatives.

CS-5619 Advanced Topics in Information Management (3)
The contents of this course will be developed by the instructor based on the emerging topics of interest and active research in the said area.

CS-5630 Machine Learning and Neural Networks (3)
This course will cover: Machine learning, Neural Networks, Density estimation, Supervised learning, Linear and logistic

CS-5631  Decision Support System  (3)
This course will cover: Introduction to DSS, Decision Making, Exploring the Range of DSS research, Knowledge Management, Model Oriented DSS, Visualization-oriented DSS, Business intelligence and data warehousing, Web-based & Distributed DSS Architectures, Spatial DSS.

CS-5632  Knowledge Based System  (3)

CS-5633  Natural Language Processing  (3)
This course will cover: Applications of NLP techniques (MT, grammar checkers, dictation, document generation, NL interfaces), The different analysis levels used for NLP (morpho-lexical, syntactic, semantic, pragmatic) markup (TEI, UNICODE), Finite state automata, Recursive and augmented transition networks, Lexical level, Error-tolerant lexical processing (spelling error correction), Transducers for the design of morphologic analyzers, Features, Towards syntax: Part-of-speech tagging (Brill, HMM), Efficient representations for linguistic resources (lexica, grammars,...): tries and finite-state automata, Syntactic level, Grammars (e.g. Formal/Chomsky hierarchy, dcs, systemic, case, unification, stochastic), Parsing (top-down, bottom-up, chart (Earley algorithm), CYK algorithm), Automated estimation of probabilistic model parameters (inside-outside algorithm), Data Oriented Parsing, Semantic level, Logical forms, Ambiguity resolution, Semantic networks and parsers, Procedural semantics, Montague semantics, Vector Space approaches, Distributional Semantics, Pragmatic level, Knowledge representation, Reasoning, Plan/goal recognition, Speech acts/intentions, Belief models, Discourse, Reference, Natural language generation, Content determination, Sentence planning, Surface realization, Other approaches, Statistical/corpus-based NLP, Connectionist NLP.

CS-5634  Human Computer Interaction  (3)
### CS-5635 Computer Vision (3)
This course will cover: Concepts behind computer-based recognition and extraction of features from raster images. Applications of vision systems and their limitations. Overview of early, intermediate and high level vision, Segmentation: region splitting and merging; quadtree structures for segmentation; mean and variance pyramids; computing the first and second derivatives of images using the isotropic, Sobel and Laplacian operators; grouping edge points into straight lines by means of the Hough transform; limitations of the Hough transform; parameterization of conic sections. Perceptual grouping: failure of the Hough transform; perceptual criteria; improved Hough transform with perceptual features; grouping line segments into curves. Overview of mammalian vision: experimental results of Hubel and Weisel; analogy to edge point detection and Hough transform; Relaxation labelling of images: detection of image features; Grouping of contours and straight lines into higher order features such as vertices and facets. Depth measurement in images.

### CS-5636 Control System and Robotics (3)

### CS-5637 Advanced Topics in Artificial Intelligence (3)
The contents of this course will be developed by the instructor based on the emerging topics of interest and active research in the said area.

### CS-5502 Advanced Operating System (3)

### CS-5503 Advanced Computer Architecture (3)
This course will cover: Introductory concepts of Computer Architecture, Computer Architecture, Organization, ISA, RISC and CISC, Computational Models, Pipelining, Instruction Set Architecture, ISA and its components, Instruction classification, modes, Performance measures (Execution time, MIPS, MFLOPS, SPEC etc), Example of RISC Computer, Instruction formats, memory maps, assembly code and reverse assembly with example computations, CPU Design, Design and evaluation for modern uniprocessor computing systems, Register Sets and types, ALU design, data path, System bus, Control Unit architecture, Parallel Processing, Parallel Computing/processing, basic concepts, Process models, thread models, Concept of concurrent execution, Parallel
Advanced Operations Research (3)
This course's emphasis is on the formulation and application of advanced operations research techniques to problem solving and the theoretical issues involved. Topics that will be covered include: Introduction to Linear and non-linear Programming, Integer programming techniques, Revised Simplex Algorithm, Dimensional Cutting Stock Problem, Dantzig-Wolfe Decomposition Algorithm, Primal-Dual Algorithm, Goal Programming-Formulations, Goal Programming Solutions Complexity of Simplex Algorithm, Integer Programming-Formulations, Solving Zero-One Problems, Cutting Plane Algorithm, Advanced dynamic programming techniques including multiple states in forward node labeling algorithms, stochastic programming, dominance criteria, lower bound estimates, and relaxed dominance criteria for generating approximate solutions, Optimization techniques, multi-objective optimization, Quadratic and other non-linear optimization problems, Sub-gradient optimization, Heuristic methods, heuristics for TSP, Lagrangean relaxation, Network Models, Shortest Path Problem, Successive Shortest Path Problem, Maximum Flow Problem, Minimum Cost Flow Problem, Branch and Bound Algorithms for TSP, Vehicle Routing Problem, Queueing Models, Single Server Queueing Models,
CS-5512  Nature-inspired Algorithms  (3)
This course will cover: Genetic Algorithms, Non-linear Programming Problem, Foundation of Genetic Algorithms, Metaheuristic Algorithms, Simulated Annealing, Tabu Search, Ant Algorithms, Particle Swarm Optimization, Bee Algorithms, The Other Nature-Inspired Metaheuristic Algorithms, and Application of these algorithms to some common optimization problems.

CS-5513  Semantic Web  (3)

CS-5514  Intelligent User Interfaces  (3)
The increasing complexity of software and the proliferation of information makes intelligent user interfaces increasingly important. The promise of interfaces that are knowledgeable, sensitive to our needs, agile, and genuinely useful has motivated research across the world to advance the state of the art and practice in user interfaces that exhibit intelligence. The text covers the topic well.

CS-5515  Digital Signal Processing  (3)
This course will cover: One- and N-dimensional signals and systems, Sampling theorem, Discrete-time Fourier transform, discrete Fourier transform, fast Fourier transform, z-transforms: stability and minimum phase signals/systems, Linear filtering of signal: Time domain: Difference equations and convolution, Impulse invariance, bilinear transform, FIR filter design, 2D filter design, Statistical signal processing: Stochastic signals: correlation functions and power density spectra, Optimal filtering: Wiener filters, Adaptive filters: LMS and array processing.

CS-5516  Theory of Programming Languages  (3)
This course will cover: the Evolution of Programming Languages, Define Syntax, Define Structure, Define Language Paradigm, Know the different language paradigms, Appreciate the relevance of this course in his future job, Apply variables, expressions and Statements, Write Concurrent and Functional programs, Complete the course requirements as scheduled.

CS-5517  Advanced Simulation and Modeling  (3)
This course will cover: Basic process modeling, Input modeling, probability concepts, Monte carlo techniques, discrete event stochastic models, Markov models, Random number generation, Random variate generation, Finite and infinite horizon simulation, Comparing alternatives, Queuing and inventory models, Entity transfer and material handling, Geographically Distributed Simulation, World reference, Data Management and distribution, Dead reckoning, Time Management in Distributed Simulations, Protocol-based methods (DIS), Infrastructure-based methods (HLA), Live / Virtual / Constructive systems, Real-time modeling, Interoperability (TENA), Hardware-in-the-loop integration, Parallel simulation, Architectures, Conservative time management, Optimistic time
### Department of Computer Science & Information Technology

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<td>CS-5519</td>
<td>Service Oriented Architectures</td>
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<td>CS-5520</td>
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<td>CS-5521</td>
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<td>CS-5522</td>
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<td>CS-5523</td>
<td>Combinatorial Optimization</td>
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<td>CS-5524</td>
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<td>CS-5650</td>
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<tr>
<td>CS-5651</td>
<td>Research Topics in Mobile and Wireless Networks</td>
<td>(3)</td>
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<td>CS-5652</td>
<td>Data Structures, The Cost of Address Translation.</td>
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<td>CS-5653</td>
<td>Network Flow and Minimum Cuts</td>
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<tr>
<td>CS-5654</td>
<td>Online Algorithms and Competitive Analysis</td>
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<tr>
<td>CS-5655</td>
<td>Graph Theory and Social Networks</td>
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<td>CS-5656</td>
<td>Advanced Topics in Algorithms</td>
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<td>CS-5657</td>
<td>Algorithms in Wireless Sensor Networks</td>
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<td>CS-5658</td>
<td>Algorithms in Cloud Computing</td>
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<tr>
<td>CS-5659</td>
<td>Algorithms in Internet of Things</td>
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This course will cover: The principles of real-time and embedded systems inherent in many hardware platforms and applications being developed for engineering and science as well as for ubiquitous systems, including robotics and manufacturing, interactive and multimedia, immersive and omnipresent applications. Real-time and quality of service system principles, understand real-time operating systems and the resource management and quality of service issues that arise, and construct sample applications on representative platforms. Platforms range from handheld and mobile computers to media and real-time server systems. Platforms may also include specialized systems used in application-specific contexts, such as autonomous robotics, smart sensors, and others.

This course will cover: An in-depth study of compiler backend design for high-performance architectures. Topics include control-flow and data-flow analysis, classical optimization, instruction scheduling, and register allocation. Advanced topics include memory hierarchy management, optimization for instruction-level parallelism, modulo scheduling, predicated and speculative execution. The class focus is processor-specific compilation techniques, thus familiarity with both computer architecture and compilers is recommended.

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This course will cover: The Rich Internet Application (RIA) Development course concentrates primarily on building rich client web applications in the browser for desktop and mobile devices, the concept and technology evolution regarding the internet applications and the use of interface tools. Mainly, the course can focus on any one of the technologies of modern day, for example, macromedia's FLASH. However, the course will use the concepts of data structures, object oriented programming, programming languages and the software design and engineering to develop projects of medium to large magnitude, technologies like HTML5, jQuery UI & Mobile, and Flex/ActionScript etc. Along with the fundamentals underlying these technologies, several applications will be showcased as case studies.

This course will cover: XML technologies, basics, namespaces, navigating XML trees with XPath, XPointer and XLink, validation, transformation and manipulation, Web technologies-HTTP protocol and early web applications, exchanging XML documents using SOAP, Service oriented architectures, technical details, design considerations, physical constraints, parameter passing, XML Considerations, Structure and architecture of SOAP, WSDL and UDDI. Develop registration and discovery techniques for Web services, SOAP Envelope, SOAP over HTTP, SOAP server, deployment descriptor, complex data types, Development and deployment of web services servers-RPC servers, WS-I servers, Generation from WSDL, Perform matchmaking on service oriented architectures, Develop registration and discovery techniques for Web services.

This course will cover: The principles of real-time and embedded systems inherent in many hardware platforms and applications being developed for engineering and science as well as for ubiquitous systems, including robotics and manufacturing, interactive and multimedia, immersive and omnipresent applications. Real-time and quality of service system principles, understand real-time operating systems and the resource management and quality of service issues that arise, and construct sample applications on representative platforms. Platforms range from handheld and mobile computers to media and real-time server systems. Platforms may also include specialized systems used in application-specific contexts, such as autonomous robotics, smart sensors, and others.

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Online Scheduling, Online Optimization with Uncertain Information. Randomization in Online Algorithms.

**CS-5651 Energy Efficient Algorithms (3)**

**CS-5652 Algorithm Engineering (3)**

**CS-5653 Combinatorial Optimization (3)**

**CS-5654 Algorithmic Game Theory (3)**

**CS-5655 Graph Theory and Social Networks (3)**
Introduction, Motivation, Random network models, Network Centrality, Community, Small world network models, optimization, strategic network formation and search, Contagion, opinion formation, coordination and cooperation, applications of SNA.

**CS-5656 Advanced Topics in Algorithms (3)**
The contents of this course will be developed by the instructor based on the emerging topics of interest and active research in the said area.

**CS-5597 Vehicular Networking (3)**
Vehicular networking promises to improve the traveling experience on roads. Vehicles and Road-Side-Units (RSUs) with sensing capabilities are now able to collect information about the road and traffic situations with exceptional detail and ubiquity. As the motor industry aims to equip vehicles with the Dedicated Short Range Communication (DSRC) technology, we may soon experience services of a sustainable Intelligent Transportation Systems (ITS) with an aim to make traveling safer, comfortable and environmentally friendly. The focus of this course is to introduce the communication characteristics of inter-vehicle communication. Importantly, for a field which is attracting increasing commercial interest, you will learn about the future trends of this technology, its problems, and solutions to overcome them.

**CS-5598 Research Topics in Mobile and Wireless Networks (3)**
This course is primarily research oriented with a
NIUIP was established in December 2010 with Higher Education Commission (HEC) funding. It is committed to promote sustainable urban development in Pakistan, and apply research in combating challenges being faced by rapidly growing urban centers in the country. NIUIP is the first dedicated institute for Urban Infrastructure Planning and Engineering in Pakistan. NIUIP is playing a central role in responding to the challenges of service delivery and infrastructure planning and engineering in key areas such as Water Supply and Sanitation, Waste Management, Land Use and Transportation Systems, Energy and Environment, and GIS Modeling.

NIUIP is equipped with state of the art technologies and equipment such as satellite imagery, simulation modeling for water supply and sewerage systems, Oracle Database software, GPS and remote sensing tools, digital plotters, fully equipped GIS lab with GIS scanners and GIS software, statistical analysis software, and a fully equipped Library.

**DIRECTOR**
Dr. Rashid Rehan Ph.D. (Canada)

**PROFESSOR**
Dr. Rashid Rehan Ph.D. (Canada)

**ASSISTANT PROFESSORS**
Dr. Salman Saeed Ph.D (Canada)
Dr. Muhammad Sagheer Aslam Ph.D (Canada)
Dr. Muhammad Tariq Khan Ph.D (UK)

**LECTURERS**
Dr. Zawar Hussain Khan Ph.D. (Canada)

---

**CS-5523 Introduction to Bioinformatics (3)**
This course provides an introduction to the field of Bioinformatics, an intersection of biology and computing. Fundamental concepts and methods in bioinformatics are discussed in this course. It surveys a wide range of topics including computational sequence analysis, sequence homology searching and motif finding, gene finding and genome annotation, protein structure analysis and modelling, genomics and SNP analysis, DNA microarrays and gene expression analysis, Proteomics, network/systems biology, and biological knowledge discovery.

**CS-5522 Special Topics in Computer Science (3)**
The contents of this course will be developed based on the emerging topics of interest and research areas in computer science.

**CS-5199 MS (CS) Thesis (6)**

**CS-6199 PhD (CS) Thesis (1-9)**
National Institute of
Urban Infrastructure Planning (NIUIP)

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Dr. Muhammad Tariq Khan Ph.D (UK)

LECTURERS
Dr. Zawar Hussain Khan Ph.D. (Canada)
OBJECTIVES

- To develop it into a center of excellence for teaching, research, and training in urban infrastructure planning in Pakistan.
- To conduct research in emerging trends in urban planning and management.
- To identify and disseminate global best practices in urban planning and management.
- To develop national and international strategic partnerships for collaborative research.
- To train in-service professionals in government and non-government organizations in urban infrastructure planning.

PROFESSIONAL AND ADVISORY SERVICES

NIUIP is active in providing advisory and consultancy services on urban infrastructure project planning initiatives in Pakistan. NIUIP is striving to act as a think-tank for important policy making and regulatory issues, and standards for urban planning projects. NIUIP provides services in:

- Master planning of water supply systems.
- Master planning of sewerage systems.
- Transportation planning.
- Best management practices in urban watershed management.
- Low cost waste disposal systems.
- Environmental issues and regulatory compliance.
- Storm water system design.
- Condition assessment and asset management of water & sewerage facilities.

AREAS OF RESEARCH AND STUDY

In addition to the core courses, students seeking post-graduate degree at NIUIP (infrastructure engineering degree or infrastructure planning degree) will have the option to select a specialized area of research and study. Accordingly, elective courses and research thesis can be selected from the following areas of specializations:

- Infrastructure Planning
- Urban & Regional Planning
- Urban Hydrology and Hydraulics
- Land use Planning.
- Urban Transportation Planning.
- Water Supply and Sanitation.
- Solid Waste Management.
- Spatial Modeling and GIS.
- GIS Application to Infrastructure Projects.
- Infrastructure Development and Finance.
- Infrastructure Utilities Planning & Service Delivery

NIUIP OFFERS

- M.Sc and Ph.D. Degree programmes in:
  - Urban Infrastructure Engineering
  - Urban Infrastructure Planning & Management

ELIGIBILITY CRITERIA FOR M.Sc. URBAN INFRASTRUCTURE ENGINEERING DEGREE PROGRAMME:

Bachelor’s degree in any of the following disciplines:

- Civil Engineering,
- Transportation Engineering
- Water resource Engineering
- Sanitary Engineering
- Environmental Engineering
- Geoinformatics Engineering
## URBAN INFRASTRUCTURE ENGINEERING

### LIST OF APPROVED COURSES

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<td>C</td>
<td>UIE 5804</td>
<td>Computer-Aided Infrastructure Design, Construction &amp; Management</td>
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<td>UIE 5808</td>
<td>Infrastructure Condition Assessment</td>
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<td>UIE 5809</td>
<td>Infrastructure Asset Management</td>
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<td>UIE 5815</td>
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<td>D</td>
<td>UIE 5803</td>
<td>Operation and Maintenance of Bridges and Building Infrastructure</td>
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**Mandatory**

*Masters students are required to take at least one course from each of the above courses groups. Contents of courses bearing codes UIP and CE are in the respective sections of the prospectus on Urban Infrastructure Planning & Management and Civil Engineering programs, respectively.

### UIE 5801: WATER SUPPLY SYSTEMS (3)

Process Technology covering water chemistry, water microbiology and process technology. World Health Organization standards and National Environmental Quality Standards for drinking water. Groundwater Resources and Treatment, water quality and treatment, including conventional and advanced groundwater treatment. Surface Water Treatment: water quality of lakes and rivers, bank filtration, coagulation and flocculation processes, chlorination and advanced disinfection. Water Treatment Processes and Plants: surface water collection and storage, water treatment processes and plants, operation and maintenance of water treatment plants, process and quality control. Water Transport and Distribution: introduction to water transport and distribution, pumping stations, urban water demand management, design of water supply networks, operation and maintenance of water supply systems, management of groundwater and surface water resources.

### Recommended Books

Recommended Books

1. Grigg, N.S "Water, Wastewater, and Storm-water Infrastructure Management" CRC Publishers

UIT 5803: OPERATION AND MAINTENANCE OF BRIDGES AND BUILDING INFRASTRUCTURE (3)

Causes of damage/deterioration, Traffic and environmental information, historical design and construction data, Inspection, levels of inspection, visual, non-destructive testing, sample selection, Bridge assessment, risk analysis and reliability analysis, Theoretical analysis, Static and dynamic load testing, material properties and relationship to capacity, relationship between bridge deterioration and reduced load capacity. Bridge condition assessment and rating, performance measures and technology used in condition and inventory data collection, Bridge information and management systems, whole of life costing and other economic considerations, maintenance, rehabilitation and replacement, reliability based assessment and management, Bridge deteriorations models under different loading and environmental conditions.

Recommended Books

1. Bridge Engineering: Design, Rehabilitation, and Maintenance of Modern Highway Bridges by Demetrios E. Tonias

UIT 5804: COMPUTER-AIDED INFRASTRUCTURE DESIGN, CONSTRUCTION AND MANAGEMENT (3)

Introduction to various CAD environments for infrastructure design, construction and maintenance, Application
of building information modeling approach for effective design/build/operation and maintenance of infrastructure, integrating GPS/total station surveying data in civil engineering design, computer aided hydrological design, graphical presentation of design using multi-color coding schemes, civil infrastructure inspections using 3d computer simulations.

Software Used: AutoCAD Civil 3D

**UIE 5805: INTELLIGENT TRANSPORT SYSTEMS (3)**


**Recommended Books**

4. Intelligent Transportation Realizing the Benefits (proceedings of 1996 Annual Meeting of ITS America.

**UIE 5806: URBAN TRAFFIC MANAGEMENT (3)**

Traffic Management definition, Basic principles of traffic flow road hierarchy, Key road traffic management issues, Congestion, Supply side remedies, Demand side remedies; Safety, Road accidents detection and prevention, Education, Enforcement and geometric design of various road elements; Traffic management and Environment. Network optimization principles and tools namely, one-way traffic flows, area wide traffic signal coordination systems and network simulation models; Parking management solutions and techniques; Pedestrian and cycling networks design principles. Light Rail Transit Prospects and Problems:

Arterial roads integrated management solutions;
Public transport priority oriented infrastructure management solutions namely bus lanes etc.;
UIE 5811: APPLICATION OF GIS/RS FOR URBAN INFRASTRUCTURE PLANNING AND MANAGEMENT (3)

Sources of spatial data and methods of spatial data collection (digital map data, handheld GPS, aerial photography, satellite imagery, etc.), processes required to combine various sources of data for spatial analysis; Visualizing urban and regional planning data using GIS, Compiling data using GIS to support Urban, regional and disaster planning, Designing GIS map layouts to support Urban Infrastructure Planning tasks, Analyzing GIS data, Understanding data accuracy issues, understanding key GIS implementation issues.

Recommended Books


UIE 5812: DISASTER PREPAREDNESS & MANAGEMENT (3)

Visualizing data required for Security/Disaster Planning operations, Preparing disaster scenario maps and warning reports, Preparing, Locating and Protecting Critical Infrastructure, Locate and Protect Impacted Population, Shelter Planning, Preparing Disaster Response and Recovery strategies using GIS and Google Earth, Using vulnerability analysis, multi-hazard mapping, and shelter planning for disaster relief operations, identifying and capturing data necessary for disaster planning and recovery, using of tools such as GIS to support emergency management analysis, Organizing disaster management data.

Recommended Books


UIE 5814: ENERGY AND WATER CONSERVATION PLANNING & MANAGEMENT (3)

This course will reviews the range of energy resources available to humankind, identifies trends in the uses of such resources, examines major problems associated with such trends, and discusses the major policies and organizations that have evolved to address such problems. The course also include the study of energy conservation methods and techniques to reduce environmental pollution problems associated with energy use, including energy auditing, energy management economics, and demand side management. The course will also cover water conservation planning and management including water conservation measures in a watershed management framework, reduction of water losses, and water harvesting.

UIE 5815: DYNAMICS OF URBAN INFRASTRUCTURE SYSTEMS (3)

Introduction to urban dynamics, structure of an
urban area, Structure and behaviour of dynamic systems – basic concepts in System Dynamics,
Overview of the international legal framework and guiding principles of humanitarian action, Risk management tools, Contingency planning and disaster preparedness, Planning the response – Hygiene, SPHERE and other standards followed by international humanitarian organizations, Emergency planning and management, Decision making, Monitoring and reporting.

Recommended Books

1. Emergency Sanitation: Assessment and Programme Design, P. Harvey, S. Baghri, and B. Reed, WEDC, Loughborough University, United Kingdom, 2002

2. Emergency water sources: Guidelines for selection and treatment. 3rd edition (3rd edn), S. House and B. Reed, WEDC, Loughborough University, United Kingdom, 2004


UIE 5890: SPECIAL TOPICS (3)
Any subject relevant to Urban Infrastructure Engineering

UIE 5899 MASTER’S THESIS (6)
UIE 6899 PhD THESIS (9)
Urban Infrastructure Engineering
Urban Infrastructure Planning & Management (Degree Programme)

NIUIP also offers master’s degree program in Urban Infrastructure Planning and Management, in addition to the M.Sc degree program in Urban Infrastructure Engineering.

The magnitude and dynamics of urbanization place an enormous burden on organizations responsible for the planning and management of urban regions. The core objectives of urban planning and management are seen as understanding dynamic urban processes and developing effective interventions that contribute to the sustainability of urban development.

The M.Sc. degree program in Urban Infrastructure Planning & Management trains the students in the current practices and research in the field of urban planning and management. Major areas of study and research include:

1. Urban and Regional Planning
2. Environmental Laws in Urban Planning
3. Land Use Regulation and Enforcement
4. Census Data Analysis & Policy Making
5. Urban Housing
6. Urban Economics & Real Estate Markets
7. Sustainable Urban Infrastructure Planning & Management
8. Infrastructure Utilities Planning
9. Urban Development & Design
10. Financing of Infrastructure Projects

ELIGIBILITY CRITERIA FOR M.SC URBAN INFRASTRUCTURE PLANNING & MANAGEMENT DEGREE PROGRAM:

Undergraduate degrees (04 years Bachelors i.e. total of 16 years education) or postgraduate degrees (02 years masters i.e. total of 16 years education) in fields of:

- Architecture
- Town planning
- Urban and regional planning
- Environmental sciences
- Geography

In addition to above mentioned fields the students having Bachelor Degree in any of the following engineering fields are also eligible for M.Sc Urban Infrastructure Planning & Management Degree Program:

- Civil Engineering
- Transportation Engineering
- Water Resource Engineering
- Sanitary Engineering
- Environmental Engineering
- Geoinformatics Engineering
- Agriculture Engineering
- Industrial Engineering
- Engineering Management
LIST OF APPROVED COURSES

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**Mandatory
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**Course contents can be found in the section on Civil Engineering programs**

**UIP 5815: LAND USE REGULATION AND ENFORCEMENT (3)**

The objective of this course is to provide students with the tools that are needed for managing and regulating land use in today's political environment. The roles of planners, citizens, and various units of government will be examined as it relates to regulating land use. The course deals with practical land use planning and regulatory techniques that provide an opportunity for planners to be successful in implementing plans and related ordinances. The course will also provide students with an understanding of the techniques, processes, and strategies of land use planning. Other related topics include land use and urban development regulations and their enforcement, land use zoning regulations, urban land use planning system and infrastructure development system, zoning districts, subdivision control and methods of community building, constitutional and statutory limits on land use regulations, smart growth and other flexible land use strategies and housing and urban redevelopment.

**UIP 5816: CENSUS DATA ANALYSIS & POLICY MAKING (3)**

This course will focus on the use of census data for growth analysis and related policy making. This course will give students the tools to calculate and compare market-driven growth to vision-driven growth, analyze population projections. Topics covered in the course include census basics, census geography, history of census data in Pakistan, community surveys in support of census, census products, analysis of census data, census data analysis tools, relationship of census
and growth in urban communities both in the past as well as future growth projections. Finally, the course will relate the census data analysis to policy making and how it can be effectively used as a tool to better manage and implement growth and urbanization policies.

**UIP 5817: URBAN HOUSING (3)**

This course examines the institutional framework within which urban housing services are delivered, and the practical implications of the housing market. It will review the following concepts and examine their application in the production of housing services. Demand factors such as population distribution and household formation, household income, the financial markets and credit, and the impact of these factors on particular groups in the population or categories of households, are included. Supply factors, including land, the organization of the construction industry and efficiency of production will be discussed. Topics such as housing search, pricing, filtering, gentrification, renovation, conservation and market failure will be included. This course will also assess housing policy options and the contributions planners can make to the supply of affordable, adequate and appropriate housing. It presents the many factors influencing the housing market and analyzes public and private initiatives affecting the provision of housing. It shows the interdependence between housing and social service planning and analyzes issues regarding the choices among housing and other social policies.

**UIP 5818: URBAN ECONOMICS AND REAL ESTATE MARKETS (3)**

This course examines the economic principles involved in land development and planning and other related forces that shape cities. It examines the factors that determine land value and land uses. It presents models of urban spatial structure and discusses issues in land development, planning and taxation. This course is also an introduction to the concepts, planning principles and analytical methods involved in making key decisions regarding real estate markets. This course examines real estate market research, for residential, retail, commercial, and office type real estate. Market analysis and developments are studied through lectures and case study discussions. The course will include evaluation of the investment merits of large, existing income-generating properties and commercial assets of urban areas.

**UIP 5819: SUSTAINABLE URBAN INFRASTRUCTURE PLANNING & MANAGEMENT (3)**

This course is aimed at an exploration of the interrelationship between land-use planning and infrastructure provision, especially transport, water, sewerage, and solid waste management facilities. It will examine the policy and regulatory frameworks for providing sustainable infrastructure facilities and the associated methodology of
Urban Infrastructure Planning & Management

planning and management of such facilities. Focus will be on master planning for such facilities based on land use patterns, population, and long-term planning for urban communities. The course will explore various theories and frameworks used in planning, public affairs, and social sciences for understanding and implementing sustainability as it relates to urban infrastructure.

UIP 5820: INFRASTRUCTURE UTILITIES PLANNING (3)
This course is intended for urban infrastructure planners to study the institutional, management, and policy frameworks for setting up municipal infrastructure utilities that are responsible for providing municipal services for an urban community. These will be studied in the context of improving the efficiency and effectiveness of public works departments and urban municipalities in providing services related to urban infrastructure such as water, sewer, and waste management services. The course will also include an emphasis on public/private partnerships as it relates to planning and setting up such utilities for the provision of urban municipal services. Field visits will be conducted in relevant agencies and authorities of Pakistan such as WASA (water and sewer authority) to study their overall planning and management frameworks.

UIP 5821: URBAN DEVELOPMENT AND DESIGN (3)
This course will introduce basic concepts in urban development and design, nature of urban design with emphasis on the public realm of cities and urban design, urban design processes and procedures. Course also includes the evolving topology of urban design projects, traditional design professions and their products for urban design, architectural design process and its phases including understanding the context, exploring possibilities, and developing the design. Case studies will be carried out to get practical experience of the processes as they relate to urban design.

Recommended Books


UIP 5822: URBAN AND REGIONAL PLANNING (3)
Main types of planning tasks including urban management, site selection, impact assessment, and strategic planning, land use theory and land use zoning. Role of urban and regional planning in making decisions about the natural and built environments, Planning techniques and principles to handle important issues such as traffic management, land use controls, and ecologically sustainable development. Reactive and proactive planning, Analysis and presentation of spatial data.
Recommended Books


UIP 5823: ENVIRONMENTAL LAWS & POLICY MAKING (3)


Recommended Books


UIP 5824: QUANTITATIVE METHODS AND STATISTICS IN PLANNING (3)

This course introduces students to basic methods of quantitative analysis used by urban and regional planners. It introduces methods for exploring and presenting data, analyzing relationships between variables and testing hypotheses. The course will introduce concepts of fitting data to various statistical models such as linear regression and multiple linear regression models. Students will also become familiar with STATA, statistical analysis software used by planners for such analyses.
Urban Infrastructure Planning & Management

**UIP 5825: FINANCING OF INFRASTRUCTURE PROJECTS (3)**


Recommended Books


**UIP 5826: UTILITY FINANCING AND SERVICE DELIVERY (3)**

This course is intended for urban infrastructure planners to study the financial and revenue generation frameworks as it relates to utility financing of urban infrastructure utilities that are responsible for providing municipal services for an urban community. Examples of such utilities include those providing water, sewer, and waste management services. These will be studied in the context of improving the efficiency and effectiveness of such utilities and to facilitate the service delivery of such utilities. The course will also include an emphasis on public/private partnerships as it relates to financing such utilities for the provision of urban municipal services and the issues related to the generation of revenues as needed to support the financial sustainability of such utilities. Field visits will be conducted in relevant agencies and authorities of Pakistan such as WASA (water and sewer authority) to study their overall financing and revenue generation frameworks.

**UIP 5827: URBANIZATION AND URBAN SPRAWL (3)**

Basic concept and definition, Urbanism / Urbanization trends, and its causes; scale & pace of urbanization at national and international level, City and its region; Rural Urban Fringe/Peri-Urban Area, Suburbs, Satellite Town, Metropolitan area, Conurbation, Decentralization/Deconcentration policy in response to urbanization, garden city movement, British new Towns, Planned cities/new towns of Pakistan, Development of Intermediate cities.

Urban Infrastructure Planning & Management

regulations, Institutional issues, Community participation in plan making, Time horizons & sustainability. Urban problem and challenges, Institution & financial frame work for future development, prospective policy issue with special reference to Pakistan: Future of Pakistani cities

Recommended Books


UIP 5890: SPECIAL TOPICS (3)
Any subject relevant to Urban Infrastructure Engineering

UIP 5899  MASTER'S THESIS (6)
UIP 6899  PhD THESIS (9)
Department of Basic Sciences & Islamiat

The Department of Basic Sciences and Islamiat is creating availability of a good offer to the students who are interested to study advanced mathematics with a favor of application to various engineering disciplines. This programme in mathematics is for those who want to study mathematics along with focus on applications. We offer a wide range of courses in advanced topics in Computational Mathematics, Differential Equations, Mathematical Modeling, Fluid Mechanics, Numerical Methods, Algebra, Mathematical Analysis, Complex Analysis, Differential Geometry, Topology, Applied functional Analysis and Mathematical Logic.

The fundamental tool needed in engineering and computer science, is mathematics. Applied mathematics is used to model the physical world around us. It helps us to predict the weather, model population changes and describe how our sun works. Designing airplanes, constructing bridges and fiber optics would not be possible without applying mathematics. The demand for applied mathematicians is increasing day by day as more and more information is stored, transmitted and proceeded using computers and networks. This requires use of several mathematical techniques. Computerized mathematical modeling plays an increasingly decisive role within engineering sciences with the advance of modern high performance computers and increase in the size and explicitly of computational problems. The interplay between the mathematical modeling, the numerical algorithms and the computer implementation has become increasingly important. This interplay is at the heart of today’s scientific computing. The Master and Ph.D. programmes give a thorough exposition to topics in mathematical modeling and scientific computing arising in the proposed areas of research. The proposed areas of research have wide ranging application in Medical & Engineering Sciences, Industries and Business etc.

CHAIRMAN
Prof. Dr. Siraj-ul-Islam Ph.D. (Pak)

PROFESSORS
Prof. Dr. Siraj-ul-Islam Ph.D. (Pak)
Prof. Dr. Amjad Ali Ph.D. (Pak)
Prof. Dr. Ali Muhammad Ph.D. (Pak)

ASSOCIATE PROFESSOR
Dr. Marjan-ud-Din Ph.D. (Pak)

ASSISTANT PROFESSORS
Mr. Kifayat Ullah M.Sc. (Pak)
Mr. Javed Iqbal M.Phil (Pak)
Dr. Noor Badshah Ph.D. (UK)
Dr. Muhammad Humayun Ph.D. (Pak)
Dr. Iltaf Hussain Ph.D. (Pak)
Dr. Tufail Ahmed Khan Ph.D. (Pak)
Dr. Rehan Ali Shah Ph.D. (Pak)

LECTURERS
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Mr. Gul Shed MS (Pak)
Mr. Said Anwar Shah MS (Pak)
Mr. Atta-ur-Rehman MS (Pak)
Mr. Qayyum Shah MS (Pak)
Mr. Iqbal-ud-Din Arif Utman M.Phil (Pak)
Mr. Jamal Nasir MS (Pak)
Miss. Gulandam Farhat M.A. (Pak)
Mr. Haseen Ullah Jan M.Phil (Pak)
Mr. Ehtiram-ul-Haq M.Phil (Pak)
Mr. Sadam Hussain M.A. (Pak)
Miss. Shaista M.A. (Pak)
MS DEGREE PROGRAMME IN MATHEMATICS
The MS degree programme in Mathematics at the Department of Basic Sciences & Islamiat, shall extend over a period of at least two years (4-Semester). A total of 32 credit hours (including 26 credit hours of courses and six credit hours of research) are required to complete the MS (Mathematics) programme. The 26 credit hours from the area of specialization and 2 credit hours of the course "Research Methodology". This course will be registered as credit course.

PH.D. DEGREE PROGRAMME IN MATHEMATICS
Department of Basic Sciences intends to offer Ph.D. programme in the emerging fields of applied/computational mathematics to produce researchers who are competent in terms of research productivity at national and international level.

The general rules and regulations for Ph.D. programme in Mathematics will be as per rules mentioned in the Postgraduate Prospectus.

ELIGIBILITY
1. Candidates seeking admission must have M.Sc in Mathematics (16 years) or BS four years degree from accredited Institutions, securing at least 60% marks in annual system or at least CGPA 3 in the semester system.
2. Candidates seeking admission must score at least 50% minimum marks in ETEA GAT (General) or GRE (General) international.
3. Candidates shall have to pass departmental subject test with 50% minimum marks. Final merit shall be made based on the combined results of ETEA marks and the departmental test.

Recommended Books:
LIST OF APPROVED COURSES FOR MS PROGRAMME IN MATHEMATICS

The following 12 courses are core courses:

1. BSI-5011  Partial Differential Equations (3)
2. BSI-5025  Mathematical Statistics (3)
3. BSI-5034  Numerical Linear Algebra (3)
4. BSI-5017  Mathematical Modeling and Numerical Simulation
5. BSI-5018  Mathematical Methods (3)
6. BSI-5028  Applied Functional Analysis (3)
7. BSI-5671  Numerical Methods for Partial Differential Equations (3)
8. BSI-5558  Differential Geometry-I (3)
9. BSI-5040  Integral Transform and its Applications (3)
10. BSI-5560  Meshless and other Advanced Numerical Method (3)
11. BSI-5674  Advance Fluid Dynamics (3)
12. BSI-5030  Mathematical Biology (3)

BSI 5011  PARTIAL DIFFERENTIAL EQUATIONS (Core: 3)

Recommended Books:

BSI 5017  MATHEMATICAL MODELING AND NUMERICAL SIMULATION (Core: 3)
Prerequisites: Nil
Model and its different types, Deterministic models, Statistical models, Stochastic models, Formulation of a model, Laws and conservation principles, Discrete and continuous models, Manipulation into its most respective form, Evaluation of a model. Case studies, Continuum model, Transport phenomena, Diffusion and air pollution models, Microwave heating, Communication and Information technology.

Software Support: MATHEMATICA, LSODE, GNUPLOT, MATLAB.

Recommended Books:
5. Y. C. Fung, A First Course in Continuum Mechanics,
BSI 5018  MATHEMATICAL METHODS (Core: 3)

Recommended Books:

BSI 5020  STATISTICAL DECISION THEORY (3)

Recommended Books:

BSI 5021  PARALLEL ALGORITHMS (3)
Theoretical models of parallel computation: Variants of the PRAM model. Performance of parallel algorithms.


Recommended Books:
BSI 5025  **MATHEMATICAL STATISTICS (Core: 3)**

Univariate probabilistic and deterministic models, Methods of estimation, Composition of confidence intervals and testing, Optimal tests and confidence intervals, Likelihood ratio tests, Linear models, Regression and correlation, Analysis of variance, Analysis of discrete data, Non-parametric models, Decision theory, Markov processes.

Recommended Books:


BSI 5028  **APPLIED FUNCTIONAL ANALYSIS (Core: 3)**

Applications to bounded linear functional, Application to submmability of sequences, Numerical Integration and weak* convergence, Banach fixed point theorem and its applications to linear equations, differential equations and integral equations, Unbounded linear operators in quantum mechanics.

Recommended Books:


BSI 5029  **MULTIGRID METHOD FOR LINEAR AND NON-LINEAR PDES (3)**

Stencil Notations for differential operators, Ingredients of Multigrid, Error smoothing procedure, Two-grid cycle, Multigrid components, Linear Multigrid cycle, Full Multigrid (FMG), Local Fourier Analysis (LFA), Solution of Poisson equation in 2D and 3D, Non-linear Multigrid.

Recommended Books:

BSI 5034 NUMERICAL LINEAR ALGEBRA (Core: 3)
Matrix-Vector operations, Orthogonal vectors and matrices, Matrix and vector norms, Singular value decomposition (SVD), Projectors and QR factorization, Gram-Schmidt orthogonalization process, Householder triangularization, Least-squares problems, Condition numbers, Gaussian elimination and LU factorization, Pivoting and LUP factorization, Stability of Gaussian elimination, Cholesky Factorization, Overview of eigenvalue problems, Reduction to upper- Hessenberg Tridiagonal form, Power and inverse power iteration, QR algorithm without shifts, QR algorithm with shifts, Arnoldi iteration, GMRES method, Lanczos iteration Orthogonal polynomials and Gauss quadrature, Conjugate gradient (CG) method, Bi-Orthogonalization method.

Recommended Books:
5. E.D Rainvulle, Special functions, Macmillan and Co.

BSI 5058 ADVANCED COMPLEX ANALYSIS (Core: 3)
Contour Integration:

Recommended Books:
5. E.D Rainvulle, Special functions, Macmillan and Co.

BSI 5043 THEORY OF SPLINES AND ITS APPLICATION (3)
Properties of polynomial and piecewise polynomial, or spline, curves, Bernstein polynomials and B-spline functions, De Casteljau and De Boor algorithms, Bezier and B-spline curves, tensor product surfaces.

Recommended Books:
Lemma, Applications of Laplace Transforms to PDEs Solution of BVPs, Application of Joint Laplace and Fourier Transforms, Hankel Transform, Application of Hankel Transform to PDEs Mellin Transform, Application of Mellin Transform to PDEs.

Recommended Books:
2. Integral Transforms and Their Applications by B. Davies, 2nd Sub edition (November 1993)

**BSI 5057** SPLINE THEORY AND ITS ANALYSIS (3)

Brief review of polynomial interpolation and its limitations, Piecewise linear approximation and piecewise cubic interpolation, Representation of piecewise polynomial functions, The B-spline basis and stable evaluation of splines and B-splines, B-spline series and local spline approximation methods, Spline Interpolation, smoothing and least squares approximation, Surface interpolation by tensor-product splines, Topics in multi-variate splines, box splines, Other topics depending on topics and interests.

Recommended Books:

**BSI 5030** MATHEMATICAL BIOLOGY (Core:3)


Recommended Books:
1. Introduction to smooth manifolds by John M. Lee.
2. Natural operation in Differential Geometry by Ivan Kolar, Peter W. Michor and Jan Slovak.

**BSI 5559** GENERAL RELATIVITY (3)

Manifold Theory: Manifolds, Maps of manifolds, Lie Derivatives, Vectors (Tangent vectors), vector field...
Mathematics

(Tangent field), Vector space (tangent space) at a point, Differentiability of vector fields, Classification of some important tensors: symmetric tensors, Classification of 2 spaces in the tangent space, Bivectors and their classification, Classification of second order symmetric tensors, Classification of the Riemann tensors. Petrov classification of the Weyl tensor, Curvature and curvature Collineations. Derivative operators and parallel transport, curvature of more than 2-dimensional manifolds, geodesics and Geodesics equation, Methods for computing curvature, Symmetries in General Relativity: Killing symmetry, Homothetic symmetry, affine symmetry, conformal symmetry, projective symmetry.

Recommended Books:


LIST OF APPROVED Ph.D COURSES

BSI 5671 NUMERICAL METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS (Core: 3)

Recommended Books:


BSI 5672 NUMERICAL GRID GENERATION & FLUID FLOW COMPUTATIONS

Governing equations of fluid dynamics and their various levels of approximation; Numerical methods like FDM, FVM, Meshless Methods; Introduction to geometrical aspects of simple and complex bodies; grid/mesh generation Methods; Algebraic, PDE based mesh generations with examples; Exercises on flow computations.

BSI 5673 NONLINEAR DYNAMICS AND CHAOS

Implications of nonlinearity, dynamics and chaos, The role of dimensionality, One-dimensional systems, One dimensional flow: visualizing the solution space, Stability and fixed points, Linear stability analysis. Existence and uniqueness, Applications and numerical methods, Bifurcations, Saddle-node, transcritical and pitchfork, Flows on the circle, Uniform and non-uniform oscillator, Two dimensional systems, Beyonds linear systems, Phase portraits, topological consequences, fixed points and linearization, Conservative versus dissipative systems, Reversible systems, Limits cycles in non-conservative systems, Chaos, Lorentz system of equations, Fractals.

Recommended Books:


BSI 5674 ADVANCE FLUID DYNAMICS (Core:3)


Recommended Books:

BSI 5675 ADVANCE NUMERICAL METHODS
A review of basic methods for the Poisson Equations on regular domain, The finite difference method, the finite element method, the finite volume method, the meshless methods, second order elliptic boundary value equations, A review of qualitative properties, Maximal principle, Existence and uniqueness (existence of classical and weak solution), Regularity (H2 regularity of the solutions for smooth or convex domain). The finite difference method: Basic finite difference schemes, Discrete maximal principle and M-matrices, Error estimates, Boundary treatments. The method of subspace corrections and its convergence properties: Conjugate gradient methods and preconditioning. Monotone schemes and Godunov theorem. Higher order methods, Nonlinear problems.

Recommended Books:

BSI 5676 DIGITAL IMAGE PROCESSING (VARIATIONAL)
Introduction to the theory and applications of 2-D signal and image processing: 2-D signals and system analysis, 2-D sampling and quantization, 2-D signals and image transforms, 2-D FIR filter design: image formation; image enhancement; image restoration; image coding; image reconstruction from projections; image compression; color image processing; current applications.

Recommended Books:
2. Geometric Partial Differential Equations And Image Analysis, by Guillermo Sapiro
3. Mathematical Problems in Image processing, by Gilles Aubert.

BSI 5677 COMPUTER VISION (VARIATIONAL)
Introduction to the theory and applications of computer vision. Topics include: image representation, image segmentation, image analysis by mathematical morphology, texture, shape analysis and 3D version.

Recommended Books:
1. Robust Computer Vision: Theory and applications by Nicu Sebe, Michael S. Lew
2. Variational, Geometric and level set methods in computer vision by Nikos Paragios, Olivier Faugeras, Tony Chen.

**BSI 5678 ADVANCED GENERAL RELATIVITY**


Recommended Books:

**BSI 5679 RIEMANNIAN GEOMETRY**

Differential geometry lies in the heart of modern theoretical physics. In particular, Riemannian geometry, a natural generalization of the familiar geometry of curves and surfaces to arbitrary dimensions, provides the natural framework within which gravitation and particle physics are studied. So differential geometry is not only a subject of great intrinsic interest, but also one with a multitude of practical applications in various other branches of mathematics. Hence differential geometry would be of wide interest, both to pure and applied postgraduate students. The main aim of the course is to give a thorough grounding in the theory of abstract differentiable manifolds and the geometric structure with which they can be quipped, particularly Riemannian metrics.

Recommended Books:

**BSI 5092 APPLIED DATA ANALYSIS TECHNIQUES**

Introduction to model building Role of assumption, sharpness of inference, application parameter zing the model, parametric models simple, multiple regression model non linear regression model, ridge regression, robust regression. Logistic regression, probit, regression. Estimation (Model based) maximum likelihood estimation, <-estimation Estimation (Methodology based) classical (parametric, semi-parametric, baysien parametric) non-parametric
model, smoothing spline, kernel regression, estimation
(Model based) kernel and smoothing methods.

Recommended Books

2. Econometric Analysis, 5th Edition by Greene

BSI 5090 SPECIAL STUDIES (3)
BSI 5091 RESEARCH METHODOLOGY (3)
BSI 5099 MASTER'S THESIS (6)
BSI 6099 Ph.D. THESIS (1-9)
Energy is prime mover of the current global societal and industrial developments. With rapid pace of human development and the modern needs, the competence level of the engineers should also be in accordance with the demand of the day. Continuous efforts are made globally to enhance the understanding, and capability of the professionals working in the field of energy generation as well as conservation. The USPCAS-E was founded with the mission to address the energy issues of Pakistan, specifically, and contribute the global efforts on energy in general. The USPCAS-E aims to focus on applied research relevant to Pakistan's energy needs, undertake sustainable policy formulation, and serves as bridge between the government, industry and academia. The USPCAS-E is a partnership between the University of Engineering and Technology, Peshawar (UET); National University of Science and Technology (NUST), Islamabad; and U.S. partner, Arizona State University (ASU). At the end of project, the centers at NUST and UET Peshawar will be sustainable hubs to address energy related issues. Collaboration between the partner USPCAS-E universities and the Higher Education Commission will help ensure institutionalization and sustainability of the center. New state of the art M.Sc. programs have been introduced which are enlisted as following:

M.Sc. Electrical Energy System Engineering  
M.Sc. Renewable Energy Engineering  
M.Sc. Thermal System Engineering  
M.Sc. Energy Management and Sustainability

Following Ph.D. Degree Programs are also offered at USPCAS-E:
Ph.D. Electrical Energy System Engineering  
Ph.D. Renewable Energy Engineering

Vision
To bridge government, industry and academia via credible applied research and sustainable policy formulation for the development of Pakistan's energy sector.

Mission Statement
The USPCAS-E, UET Peshawar supports Pakistan's economic development by strengthening relevance and responsiveness of university product including applied and policy research and skilled graduates, to the needs of public and private sectors. The Center encourages and empowers women engineers and researchers, and promotes gender equity.
**DEGREE PROGRAMS**

- M.Sc. Renewable Energy Engineering
- Ph.D. Renewable Energy Engineering
- M.Sc. Electrical Energy Systems Engineering
- Ph.D. Electrical Energy Systems Engineering
- M.Sc. Thermal Systems Engineering
- M.Sc. Energy Management and Sustainability

**Objectives**

- Help Pakistan unleash its enormous potential for economic growth.
- Become Pakistan's premier energy think tank and engage stakeholders in both industry and government.
- Improve relevance and quality of curricula, strengthen use of effective teaching methods, and upgrade graduate programs.
- Build a nationwide network for energy professionals by establishing and facilitating channels for interaction including networking sessions, workshops, and exchange programs.

**M.Sc in Electrical Energy System Engineering**

**Introduction**

It's a harsh reality that Pakistan power system, ranging from production, transmission, distribution and management has many shortcomings. Moreover less work has been done on integrating alternate energy resources with the conventional system.

This specialized energy program will specifically work on how to improve the efficiencies of existing power plants and in helping the integration of various energy sources into and rehabilitation of the present transmission and distribution system. The taught courses will help students in understanding concepts in following focus areas:

**Focus Areas**


**Eligibility Criteria**

- B.Sc. Electrical Engineering

**Seat Allocation**

Seat allocation (per semester) for Master of Science (M.Sc.) in Electrical Energy System Engineering: 30 seats with 50% allocation for female candidates as per requirement of USAID. Female candidates must fulfill the university criteria for admission in M.Sc. Program.

**Degree Requirement**

M.Sc. Program comprises of 33 Credit Hours including 3 CH course of Research Methodology:
**List of Courses in Electrical Energy Systems Engineering**

1. CAS-EESE 501  Transmission and Distribution (3)
2. CAS-EESE 502  Power System Operation and Planning (3)
3. CAS-EESE 503  Power System Stability (3)
4. CAS-EESE 504  Advance Power Electronics (3)
5. CAS-EESE 505  Electrical Energy Market (3)
7. CAS-EESE 507  Distributed Generation (3)
8. CAS-EESE 508  Electrical Energy and Environmental Systems (3)
9. CAS-EP 521  Management of Technology and Innovation (3)

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CAS-EESE 510</td>
<td>Power System Modeling and Analysis</td>
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<tr>
<td>CAS-EESE 511</td>
<td>Analysis of Faulted Power System</td>
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<td>CAS-EESE 512</td>
<td>Power System Protection and Switchgear</td>
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<td>CAS-EESE 513</td>
<td>HVDC Transmission Systems</td>
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<td>CAS-EESE 514</td>
<td>HVAC Transmission Systems</td>
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<td>CAS-EESE 515</td>
<td>Over voltages and Transients</td>
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<td>CAS-EESE 516</td>
<td>Power System Reliability</td>
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<td>CAS-EESE 517</td>
<td>Power System Control</td>
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<td>CAS-EESE 518</td>
<td>Electrical Insulation Engineering</td>
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<td>CAS-EESE 519</td>
<td>High Voltage Engineering</td>
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<td>CAS-EESE 520</td>
<td>Power System Transformers</td>
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<td>CAS-EESE 521</td>
<td>Advanced Electrical Machines</td>
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<td>CAS-EESE 522</td>
<td>Electrical Power Generation</td>
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<td>CAS-EESE 523</td>
<td>Smart Grid</td>
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<td>CAS-EESE 524</td>
<td>Distribution and Utilization</td>
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<td>CAS-EESE 525</td>
<td>Power Quality</td>
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<td>CAS-EESE 526</td>
<td>Power System Substation</td>
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<td>CAS-EESE 527</td>
<td>Generation and Integration of Renewable Energy</td>
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<td>CAS-EESE 528</td>
<td>Computer Modeling of Electrical Power System</td>
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<td>CAS-EESE 532</td>
<td>Advanced Topics in Power Electronics</td>
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<td>CAS-EESE 533</td>
<td>Network Based Grid System</td>
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<td>CAS-EESE 534</td>
<td>Automated Distributed Power System Using Data Communication</td>
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<td>CAS-REE 526</td>
<td>Risk and Reliability Engineering</td>
<td>3</td>
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<td>CAS-REE 527</td>
<td>Energy Quality management and Standards</td>
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<td>CAS-REE 528</td>
<td>Energy Audit and Planning</td>
<td>3</td>
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<tr>
<td>CAS-REE 529</td>
<td>Environment Impact assessment for Energy Systems</td>
<td>3</td>
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<tr>
<td>CAS-REE 530</td>
<td>Development &amp; Evaluation of Renewable Energy Projects</td>
<td>3</td>
</tr>
</tbody>
</table>

**CAS-EESE 501  Transmission and Distribution  [3CH]**

Distribution systems, Load characteristics, Application of distribution transformers, design of primary feeders, Design of secondary feeders, Voltage drop and power loss, calculation, Capacitor application, Distribution system automation, HV transmission systems, Review the electrical parameters of HV lines, Conductor types, bundle conductor, Corona phenomena on AC and DC lines, Radio and TV interference, Audible noise, Electrical field effect of HV lines, Insulator selection and clearances, Lightning performance, Voltage regulation.

**Recommended Book:**

1. *Electrical Energy conversion and Transport.* Karady
CAS-EESE 502  Power System Operation and Planning  [3CH]
System operation and operating tools, economic dispatch/optimal power flow studies (OPF), unit commitment, automatic generation control (AGC), and applications of dynamic programming (DP) and linear programming (LP); role of voltage stability and stability limits in power exchange, Lagrangian relaxation and Mixed Integer Programming, introduction to state estimation applications in power engineering, electric power industry in the World, Free power marketing, role of independent system operators, regional transmission organizations, and other newly formed sectors of deregulated power infrastructure, role of power markets in power engineering.

Recommended Book:
1.  Power Generation, Operation and Control, Wallenberg and Wood, John Wiley

CAS-EESE 503  Power System Stability  [3CH]
System Dynamic Performance, the Swing Equation, Synchronizing power and natural frequencies of oscillations, equal area criterion; Analytical basis for identifying modes, Synchronous Machine control, The two reaction theory, Development of the complete d and q axes equations in per unit, Formulation of the statespace equations, Equations of the one machine connected to infinite bus, Transient and sub-transient parameters, Synchronous machine simulation, Steady-state conditions and phasor diagrams, Simulation of Multi-machine Systems

Recommended Book:
1.  Power System Control and Stability by Anderson and Fouad, 2nd Edition, Wiley Inter Science

CAS-EESE 504  Advance Power Electronics  [3CH]
Basic principles of switch-mode power conversion. Concept of steady state in switching converters, volt-second and ampere-second balance, ideal switches, concept of power pole DC-DC converters Analysis and detailed design of buck, boost, buck-boost, Cuk and SEPIC converters Analysis and detailed design of isolated dc-dc converters including forward, fly-back, push-pull, full bridge and dual active bridge topologies, continuous and discontinuous current modes of operation, linearized, small-signal average models of dc-dc converters, voltage mode and current mode control design methods, design of magnetics for dc-dc converters

Recommended Book:

CAS-EESE 505  Electrical Energy Market  [3CH]
This course focuses on the market structures that exist within the electric energy industry. The course
will provide a background on basic economic theory that is necessary to understand operational objectives, pricing and incentives, market power, etc. We will discuss the history of the electric power industry, regulation, and deregulation. We will discuss dispatch optimization problems that exist in the electric industry, approaches to solving these problems, and the corresponding markets. We will discuss different pricing methods, non-convex markets, uplift payments, etc. The final part of this class will deal with a discussion on current research problems in this field.

Recommended Book:

1. Fundamentals of Power System Economics by Kirschen and Strbac, John Wiley and Sons,


Due to ultimate energy supply constraints imposed by fossil fuel and ever increasing energy demand from consumers, renewable energy is attaining much more prominent position as a promisingly viable and necessary solution. This course covers the critical technical constituents that advance electrical utilization of renewable energy. The lecture topics are divided into two modules: electric power conversion and grid integration.

Recommended Book:

1. Grid integration and dynamic impact of wind energy

by V. Vittal, R. Ayyanar, Springer

CAS-EESE 507  Distributed Generation  [3CH]


Recommended Books:

2. Integration of Distributed Generation in the Power System by Math H. Bollen, Fainan Hassan

CAS-EESE 508  Electrical Energy and Environmental Systems  [3CH]

Emission Impacts and its control in electric utilities.

Recommended Books:
2. Energy and the Environment by Robert A. Ristinen, Jack P. Kraushaar

CAS-EP 520   Research Methodology   [3CH]

Define research; research terms; research process and the principle activities, skills and ethics associated with the research process, relationship between theory and research, major quantitative and qualitative research methods, importance of research ethics and integrate research ethics into the research process, assess and critique a published journal article that uses one of the primary research methods in the field; construct an effective questionnaire that employs several types of survey questions.

Recommended Book:

CAS-EP 522   Technology Entrepreneurship   [3CH]

Recommended Book:


**CAS-EESE 588  Advanced Topics in Electrical Energy System**  
[3CH]
Advanced topics of current interest in Electrical Energy System Engineering, especially focusing current energy crises in Pakistan.

**CAS-EESE 599  Master's Thesis**  [6CH]

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**Ph.D. in Electrical Energy System Engineering**

**Introduction**

Pakistan is facing energy crisis since one decade. The solution to come out of energy crisis is not merely energy generation by traditional means, but in an integrated approach such as demand side management, the conservation and efficiency, lighting transformation and energy generation through renewable energy sources.

The electrical energy system engineering courses are designed to cover the subjects of power systems, power electronics and smart grids to impart both theoretical and practical knowledge through high quality applications-oriented postgraduate education/research based on state-of-the-art technological equipment and software associated with power systems, power electronics and smart grids.

The objective will be achieved through several parameters; such as continuing to update specific courses in the program to ensure relevance to the latest industrial changes, supporting the development of appropriate computer facilities, promoting the integration of advanced technology in all courses, and encouraging professional growth and development of the students, engineers and researchers. The program is designed to satisfy the educational needs of the community by providing a climate that fosters self-awareness, personal growth, and a desire for lifelong learning.

**Focus Areas**

Distributed Generation, Smart Grid Technologies (Power and

**Eligibility Criteria**
MS/M.Sc. in Electrical Energy System Engineering/Electrical Engineering/Electronic Engineering

**Seat Allocation**
As per USPCAS-E UET policy

**Degree Requirements**
Ph.D. Program would comprise of at least 54 credit hours, out of which at least 18 credit hours should be in the form of course work with a minimum CGPA of 3.3. This will be followed by a comprehensive examination along with thesis defense. The minimum time for the award of Ph.D. degree will be three years for full time students and four years for part time students, who must register as full time students for at least two years. All other existing rules of UET-Peshawar will be followed in this regard.

The following breakup of credit hours will be used:
- Elective Courses: 18 credits
- Thesis: 36 credits
- Total: 54 Credits

**Technical Electives**

**CAS-EESE-510  Power System Modeling and Analysis: [3CH]**


Recommended Books:

**CAS-EESE-511  Analysis Of Faulted Power System: [3 CH]**

Type of faults in power system, open and short-circuit faults, causes, symmetrical components, sequence networks, Balance and Unbalance faults, Fault Analysis by Computer Methods, Faults analysis of different components of power system, Power system stability and faults.
Recommended Books:


**CAS-EESE-512 Power System Protection and Switch Gear:** [3 CH]

Detection of System variables, Relays, Fuses and Circuit Breakers, Isolators, Earthing switches, Protection of Power Transformer, Motor, Generator, transmission and distribution lines, Voltage and Current transformers, power system condition monitoring, Protection schemes and zoning, Microprocessor based power system protection.

Recommended Books:

1. **POWER SYSTEM PROTECTION** Edited by The Electricity Training Association, The Institution of Electrical Engineers 1997.
   - **Volume 1: Principles and components.**
   - **Volume 2: Systems and methods.**
   - **Volume 3: Application.**
   - **Volume 4: Digital protection and signaling**


**CAS-EESE-513 HVDC Transmission Systems:** [3 CH]


Recommended Books:


**CAS-EESE-514 HVAC Transmission Systems** [3 CH]

High voltage Transmission Systems, Overhead lines: Electrical and Mechanical design, Electrical characteristics Corona on A.C lines, Radio and Television Interference, Audible Noise and Corona loss, Insulation Design, Electrostatic effects. HV cables, Grid systems, Inter-connections. Effect of high electric and magnetic field of HV lines, Environmental issues.

Recommended Books:

1. **EHV AC Transmission Engineering,** Rakosh Das


CAS-EESE-515 Over voltages and Transients [3CH]
Sources of over voltages and transients, Over voltages and Transient performance of Power System, Circuit Interruption, Switching and lightning transients, Travelling waves, Behavior of power system equipment under transient conditions, Protection against transient overvoltage, Arresters, Insulation coordination.

Recommended Books:

CAS-EESE-516 Power System Reliability [3 CH]

Recommended Books:
2. Assessment of Power System Reliability Methods and Applications Authors: Čepin and Marko, Springer.

CAS-EESE-517 Power System Control [3 CH]
General characteristics of System Control, Computer and Microprocessor applications, Telemetry Channel, Centralized and de-centralized control, Data Acquisition and logging, Man/machine Interface, Automatic voltage and frequency control, Automatic Generation Control, Voltage and Reactive Control, Optimum dispatch, Power Station Controllers.

Recommended Books:

CAS-EESE-518 Electrical Insulation Engineering [3 CH]
Insulation parameters, ionization and Dissociation processes, Charge transport mechanism, Thermal processes, Insulation Failure theories, Discharges...
and Insulation defects, Polarization and dielectric relaxation, Behavior in high electric and magnetic fields, Classification of insulation in terms of their Dielectric Properties. Special Purpose Insulation: Insulation for cables in nuclear environment and in Cryogenic Temperatures, Insulation for superconducting magnet coils, Insulation for cables used in space crafts, Insulation Design, Material properties, Capacitance and sheath grading, Composite Design, Determination of Voltage and Electric Field Distribution, Calculation of CFI and BIL, Insulation design for Transformers, Rotating Machinery and Underground Cables, Insulation design for overhead transmission lines.

Recommended Books:


CAS-EESE-519 High Voltage Engineering [3 CH]

Testing of Insulation, Insulation testing under lightning and switching surges, Insulation testing under HVAC and HVDC conditions, Wet and Dry Tests, Voltage withstand Tests, Non-destructive testing, Behavior of overhead line insulation under pollution, Testing and measurements plus methods of generation of HV (HVAC, HVDC and Impulse), Overvoltage's and transients.

Recommended Books:

**CAS-EESE-521 Advanced Electrical Machines**  
[3 CH]
Principles of motors and generators, Types of rotating machines, AC and DC machines, AC machine design, Electrical machines for hybrid vehicles, Application of electrical machines, Special purpose electrical machines, and Industrial applications.

**Recommended Books:**

**CAS-EESE-522 Electrical Power Generation**  
[3 CH]
Conventional and non-conventional plants, Peak load and base load plants, Thermal power stations, thermodynamics of thermal plants, Nuclear power stations, Types of reactors, Radiation safety and nuclear waste disposal, Hydroelectric power stations, Hydrology and fluid dynamics, Site selection for different power stations, Layout of power station components and installation, Environmental issues, Control of power stations, Station switchyards, Generation mix, Optimum power dispatch.

**Recommended Books:**

**CAS-EESE-523 Smart Grid**  
[3 CH]
Introduction, Smart metering and monitoring of power system equipment, Centralized control of load and generation, Load management and communication infrastructure model, NIST models, Smart grid control elements, Energy storage, Smart grid application layer, Sensors, Smart grid application related to deficient and surplus generation, Fault detection and reporting, Integration of new technologies into grid, Smart grid architecture, Economics and energy savings.

**Recommended Books:**

**CAS-EESE-524 Distribution and Utilization**  
[3 CH]
Load forecasting techniques, Consumers classification, Feeders and distributors, Urban and rural electrification, Micro-girds, Overhead and underground distribution systems, Distribution system components, Design and Analysis of distribution systems, Power factor improvement, Losses and voltage drop calculations in distributors, Demand side load management, Metering, Tariffs,
Protection of distribution system, Operation of distribution system, Utilization of electrical energy, Traction, Illumination.

Recommended Books:

CAS-EESE-525 Power Quality [3 CH]

Recommended Books:

CAS-EESE-526 Power System Substation
Introduction, Transmission and distribution substations, Outdoor and Indoor substations, Switchyard, Substation equipment, Installation and arrangement, Busbar arrangement, Grounding and Shielding, Telemetry, Power line communication system, GIS substations, Interconnections and Islanding, Substation control, Micro-grids.

Recommended Books:

CAS-EESE-527 Generation and Integration of Renewable Energy
Introduction to renewable energy sources, grid codes of Pakistan National Grid, Fault ride through criteria development, High penetration of wind and PV System in low voltage distribution systems and solution to voltage imbalance and improvement, Performance evaluation of grid connected PV Systems with different MPPT Controllers, Optimal siting and sizing of PV Systems and Wind Power Plants, Power Flow Analysis and Reactive power compensation of grid connected wind farms, Contribution of variable speed wind turbines for
frequency regulation and oscillation damping, Integration of Clean energy into distribution networks, Integration of Plug in Hybrid Electric Vehicles (PHEV) into the distribution grid, Coordinating Distributed Generation sources during emergency operations, Energy storage in fly wheels, Pumped storage hydroelectric power plants, Super capacitors, compressed air storage for clean energy sources.

Recommended Books:
1. Renewable Energy Integration Challenges and Solutions by Hossain, Jahangir, Mahmud, Apel (Eds.)
3. Renewable Energy Systems by David M. Buchla, Thomas E. Kissell, Thomas L. Floyd

CAS-EESE-528 Computer Modeling of Electrical Power System
This course covers the computer modeling of synchronous machines, transformers, transmission lines, loads, electromagnetic transients, load flow and system stability study under power electronic control.

Recommended Books:
1. Power System Control and Stability by Prabha Kundur

CAS-EESE-529 Control of Voltage Source Converter [3 CH]
Methods for design and analysis of control algorithms applied to grid-connected converters and electric drives, two-level VSCs and their pulse width modulation, current control of VSCs, synchronization of VSCs, active- and reactive-power control of VSCs, DC-bus-voltage control of VSCs, power-synchronization control of MMCs, fault ride through of MMCs, modeling and internal control of the MMC, VSC-fed drives, similarities and differences to grid-connected VSCs.

Recommended Books:
1. Control of Voltage-Source Converters and Variable Speed Drives by L. Hamefors, M. Hinkkanen, och J. Loumi
2. First Course on Power Electronics and Drives by Mnpere and Ned Mohan
4. Grid Converters for Photovoltaic and Wind Power Systems by Remus Teodorescu, Marco Liserre and Pedro Rodriguez

CAS-EESE-530 Communication and Control in Electrical Power Systems
Design, implementation and use of information and control systems for protection, automation and operation of restructured power systems.
Describe the functions of the primary equipment in the power system that is relevant for protection, automation and control. Analyze substations and simple power systems in terms of reliability protection, automation and control needs.

Describe the function and architecture of information and control systems used for protection, automation and control of power systems.

Describe the function and architecture of communication systems used for information & control systems for power system control.

Describe the importance of information & control systems for the ability to connect large amounts of renewable power sources.

Analyze and develop basic systems for substation automation and protection.

Analyze and develop basic information & control systems for system-wide control from control rooms, e.g. SCADA systems and EMS applications.

Construct a state estimator for power systems.

Describe relevant interoperability standards in the field, such as IEC 61850 and IEC 61970.

Describe the threats and risks associated with the use of information & control system for controlling the electric power system, known as Cyber Security.

Recommended Books:

1. Real Time Stability Assessment in Modern Power System Control Centers by Savu C. Savulescu

2. Smart Power Grids by Ali Keyhani and Muhammad Marwali

**CAS-EESE-531 Advanced Topics in Renewable Energy Integration**

Advanced topics of current interest in Renewable Energy Integration. Topics are selected from current technical literature based on PhD study requirement.

Recommended Books:

- To be decided by the instructor

**CAS-EESE-532 Advanced Topics in Power Electronics [3 CH]**

Advanced topics of current interest in power electronics. Topics are selected from current technical literature based on PhD study requirement.

Recommended Books:

- To be decided by the instructor

**CAS-EESE-534 Network Based Grid System [3 CH]**

Introduction to communication network, smart grid communication network (SGCN), home-area network (HAN), neighbor area network (NAN), Wide area network (WAN), wireless technologies for SGCN, Bluetooth, WPANs, Wireless mesh networks, Cellular networks, WiMAX networks, Power-line communication network for SGCN wireless routing protocols for NANS, performance metrics for routing
protocols, smart grid and smart cities

Recommended Books:


CAS-ESEE-535 Automated Distributed Power System using Data Communication

The Electric Power Systems; Generation, transmission and distribution of power grid systems, Introduction to smart grid and intelligent distribution networks, Distributed Power Generation and Energy Renewable Techniques, Energy Storage Technologies, NIST Framework and Roadmap for Smart Grid for 2020, Demand Side Management, Demand Response and Demand Pricing, FDIR and Volt-VAR Optimization - Asset Health Management, SCADA based system and computer based SCADA network, Network types for smart grid communication, Smart metering technology for smart grid, Substation communication network, IEDs, network topology, IEC61850 smart grid standard for substation automation network, Rapid Spanning tree protocol, Parallel redundancy protocol (PRP), High-availability seamless redundancy (HSR), Wireless communication technologies for substation distribution network, Network security for smart grid.

Recommended Books:

1. Real Time Stability Assessment in Modern Power System Control Centers by Savu C. Savulescu
2. Smart Power Grids by Ali Keyhani and Muhammad Marwali

CAS-ESEE 533 Engineering Economics and Management of Electrical Power System

The course presents an in-depth interdisciplinary perspective of electric power systems, with regulation providing the link among the engineering, economic, legal and environmental viewpoints. Generation dispatch, demand response, optimal network flows, risk allocation, reliability of service, renewable energy sources, ancillary services, tariff design, distributed generation, rural electrification, environmental impacts and strategic sustainability issues will be among the topics addressed under both traditional and competitive regulatory frameworks.

The course will make available the engineering, economic and legal basis to critically evaluate the regulatory instruments that are used worldwide for electricity supply activities that are performed as regulated monopolies or under competitive conditions. Most of these regulatory approaches are also of application in other industrial sectors.

The knowledge acquired in the course will provide the comprehensive understanding of electric power
systems that will be needed for research in this field, as well as for future professional activities in the energy sector, whether in industry, government or consulting.

Recommended Books:


**CAS-REE 526 Risk and Reliability Engineering [3 CH]**


Recommended Books:


**CAS-REE 527 Energy Quality Management and Standards [3 CH]**


Recommended Books:

3. How to Solar Power Your Home: Everything You Need to Know Explained Simply


CAS-REE 529 Environment Impact assessment [3 CH]
Understand the basic concepts, methodological approaches, and technological components of an Environmental Impact Assessment. Identify all applicable international Norms, National Codes and Standards concerning the environment and energy systems. Exhibit knowledge and understanding of the way that an EIA is conducted within the framework of the energy sector in Pakistan & southeast Asia.

Recommended Books:

CAS-REE 530 Development & Evaluation of Renewable Energy Projects [3 CH]
Analysis of the local situation to the final energy project: what steps have to be completed in order to implement a successful regenerative energy project.
and what factors must be considered, Survey of energy demand; methods to collect the demand for thermal and/or electrical energy until the point of development of an energy master plan, Technology of renewable energy: how to combine the various options for using renewable energy with different supply situation in the most reasonable way?, Feasibility study, requirements and content of a feasibility study, Legal framework for plant construction (including laws pertaining to construction, water and waterways, noise, etc.), Company structures; which company structure is the most appropriate for the various applications?, Risk management, Insurance, What requirements must be met in order to obtain certain types of insurance for certain renewable energy projects, Acceptance: how the acceptance of an application for the use of renewable energy can be assessed and improved?, Organization of realization of a project: how the construction phase of a renewable energy system is organized after the end of the planning period?, acceptance: Which are the acceptance steps until the regular continuous operation.

Recommended Books:


CAS-EESE 602 Ph.D. Thesis Project [36CH]
M.Sc. Thermal System Engineering (TSE)

Introduction:
The aim of M.Sc. TSE program is to train engineers in energy technologies, including a range of thermal-based energy technologies, in order to meet societal and market needs. Efficient use of thermal energy is an increasingly popular area of interest for engineers and technologists. Therefore, this program is aimed at equipping the next generation of engineers with the state-of-the-art knowledge of energy conversion, efficiency and conservation. The program will provide students with a set of courses that will improve their capacity to analyze and design innovative thermal energy systems. These systems include, but are not limited to, energy conversion systems and their fuels, refrigeration, combustion, and solar energy. The MSc specialization in TSE primarily covers advanced aspects of energy system modelling, heat- and mass transfer, fluid mechanics, thermodynamics, control engineering and experimental work with a focus on different components and energy system aspects. The themes for the three semesters are particularly focused on Thermal Energy and Process Engineering and in-depth understanding of the technologies and scientific disciplines involved in energy conversion, utilization and transport.

Program objectives:
- General understanding of the design, modeling and optimization of energy systems used in various energy production applications
- Understanding the detailed operation, functionality and interaction between the various components of key thermal energy conversion technologies
- Fundamentals and applied knowledge of building energy systems, HVAC & R technologies
- Understanding solid-state and other novel thermal energy conversion approaches, including those used for waste heat utilization
- Understanding combustion processes for optimum efficiency and minimum emissions
- Detailed insight into system integration with respect to both system efficiency and control engineering aspects of energy systems
- Developing, constructing and operating thermal energy conversion technologies in the laboratory and in real applications. Insight into the topics related to the practical realization and implementation of thermal energy technologies and systems concerning both innovative aspects, business planning and economic considerations.

Focused Areas:

Eligibility Criteria:
- B.Sc. in Mechanical Engineering
- B.Sc. in Chemical Engineering
- M.Sc./BSc in Mining Engineering
- M.Sc./BSc in Industrial Engineering.

**Seats Allocation:** Seat allocation (per semester) for Master of Science (M.Sc.) in Thermal Systems Engineering: 25 seats with 50% allocation for female candidates as per requirement of USAID. Female candidates must fulfill the university criteria for admission in M.Sc. program.

**Degree Requirement:**
M.Sc. program comprises of 33 credit hours including 3 credit hours of Research Methodology.

**Core Courses:**
15 Core Course credits required by all students enrolled in the Program.

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<tr>
<th>Course No.</th>
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<td>CAS-TSE 501</td>
<td>Advanced Thermodynamics</td>
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<tr>
<td>CAS-TSE 502</td>
<td>Thermal Power Plants design and operation</td>
<td>3</td>
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<tr>
<td>CAS-TSE 503</td>
<td>Fuels and combustion</td>
<td>3</td>
</tr>
<tr>
<td>CAS-TSE 508</td>
<td>Energy Engineering Economics and Policy</td>
<td>3</td>
</tr>
<tr>
<td>CAS-EP 509</td>
<td>Research Methodology</td>
<td>3</td>
</tr>
<tr>
<td>CAS-TSE 514</td>
<td>Thesis Project</td>
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**Elective Courses: 12 Credits**
Students to select Thesis: 6 credits.

**Elective Courses**

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<td>CAS-TSE 505</td>
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<td>CAS-TSE 506</td>
<td>Clean Coal Technologies</td>
<td>3</td>
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<tr>
<td>CAS-TSE 507</td>
<td>Computational Fluid Dynamics for Thermal Energy systems</td>
<td>3</td>
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<tr>
<td>CAS-TSE 504</td>
<td>Thermal Desalination Systems</td>
<td>3</td>
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<tr>
<td>CAS-TSE 509</td>
<td>Fuel Cell and Hydrogen Technology</td>
<td>3</td>
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</tbody>
</table>

**Detail of Courses**

**CAS-TSE 501  Advanced Thermodynamics [3CH]**

**Recommended Books:**
1. Advanced Engineering Thermodynamics by Bejan A
2. Advanced thermodynamics for engineers by D. Winterbone; Ali Turan

**CAS-TSE 502  Thermal Power Plants Design & Operation [3]**
The advanced Thermal Power Plants that are currently on the market or are under development, and design and to evaluation of system.
performance. The study will focus on natural gas combined cycle, alternatively-fueled combined cycle (i.e., coal or biomass in integrated gasification combined cycle), supercritical Rankine cycle, biomass combustion systems, internal combustion engines, and fuel cells. Also CHP systems, Solar thermal power plants and Geothermal power plants will be briefly discussed.

**Recommended Books:**

1. Power plant technology by M. M. El-Wakil
2. Thermal power plant performance analysis by De Souza, Gilberto Francisco Martha.

**CAS-TSE 503 Fuels and Combustion**

*Recommended Books:*

1. Combustion by Irvin Glassman
2. Principles of combustions by Kenneth Kuan-yun Kuo.

**CAS-TSE 504 Thermal Desalination Systems**


**Recommended Books:**


**CAS-TSE 505 Advanced Fluid Dynamics**

This course will cover principles of fluid dynamics: Tensors, model testing, description of flow fields, laws for mass, momentum and energy. Inviscid flow: Euler and Bernoulli equations, potential flow. Viscous flow: Navier-Stokes equations, boundary layers, turbulence. Element of Stability Theory. Turbulent Flows. Compressible Flows and Introduction to CFD

**Recommended Books:**

1. Fluid Mechanics: Fundamentals and Applications by Yunus A. Cengel
2. Introduction to Fluid Mechanics by Fox W. Robert, McDonald T. Alan.

**CAS-TSE 506  Clean Coal Technologies  [3]**


Recommended Books:
1. Clean Coal engineering technology by Bruce G. Miller
2. Emerging clean coal technologies by Paul W. Spaite.

**CAS-TSE 507  Computational Fluid Dynamics for Thermal Energy systems  [3]**

This course will focus on obtaining the knowledge of the computational fluid dynamic for power plants. It provides an overview of fundamental mathematical governing for fluid flow and heat transfer and Navier-Stokes equation. The course will develop the concept of turbulence and its characteristics in random fluctuation flows. The course will cover the finite volume method for steady flow and discretization schemes. The course will enlighten the concept of boundary condition and errors in modeling and simulation. The course deliberates the mesh generation strategies, modeling capabilities and CFD post processing.

Recommended Books:
2. Computational Fluid Dynamics- Principles and Applications by J. Blazek

**CAS-TSE 508  Energy Engineering Economics & Policy  [3]**

Project Cycle, Features of energy projects, project identification and development, cost concepts and financial calculations, economic evaluation of energy projects, financial evaluation of projects, environmental considerations in project evaluation, financing energy projects, risk analysis, life cycle analysis, economic analysis of public utilities, development and evaluation of CDM projects, case studies.

Recommended Books:
1. Contemporary Engineering Economics by Park C.S.
2. Economic Evaluation of Projects in the Electricity Supply Industry by Khatib H.

**CAS-TSE 509  Fuel Cell and Hydrogen Technology  [3]**

This course will cover from fundamentals to system applications of current fuel cell technologies. Following major types of fuel cells will be discussed: polymer electrolyte membrane fuel cell (PEMFC), direct methanol Fuel Cells (DMFC), Alkaline Fuel Cells (AFC), phosphoric acid fuel cell (PAFC), molten carbonate fuel cell (MCFC) and solid oxide fuel cell (SOFC). The emphasis will be the performance behavior, analysis, and modeling. Subsequently, the
balance of the fuel cell power plant, thermal system design and analysis will be discussed that affect the power generation. Finally, the components needed, issues related, and pertinent analysis will be covered to delivering electric power generated from the fuel cell.

Recommended Books:

CAS-TSE 510 Biomass Technologies
Biomass Resources and Energy Crops, Chemical and physical properties of biomass, characteristics of biomass as a fuel, Comparison to conventional fuels (coal, oil, natural gas), Energy crops for bio-energy production, pre-processing of biomass fuel for pyrolysis/gasification, principles of thermo-chemical conversion processes. Pyrolysis, Gasification, Combustion, Co-firing Energy conversion systems and CHP, Gasification Technologies, Design and Manufacturing of gasifiers, Design Challenges, Batch reactors, Continuos reactors, Multi-stage gasification, Catalytic gasification, steam gasification, Characterization of fresh and spent catalysts, synthesis gas (producer gas) and its characterization, process parameters influencing syngas composition, process optimization, state of the gasification technology, downstream processes and challenges.

Recommended Books:

CAS-TSE 511 Rotodynamic -machinery [3]
Different aspects of the rotodynamic machines will be discussed. 2D and 3D steady flow phenomena in the machine components. Major rotodynamic machinery blade design philosophies. Appropriate materials for rotodynamic machinery applications and cooling techniques. Operational aspects of thermal rotodynamic machines. Technically today’s and tomorrow’s challenges related to thermal rotodynamic machines.

Recommended Books:
1. Fluid Mechanics and Thermodynamics of Turbomachinery by S Dixon Cesare Hal
2. Turbomachinery Flow Physics and Dynamic Performance by Meinhard T. Schobeiri

CAS-REE 512 Geothermal Engineering [3]
The course topics include geothermal power generation systems. Geothermal based heating and cooling of buildings. Geothermal exploration
techniques and methods. Modeling and simulation of geothermal systems. Overall the broad objective of this course is to introduce the energy graduates with the geothermal energy systems and how they can use geothermal energy for the power generation, building applications, and other energy related applications. And graduates will be able to display advanced understanding of relevant scientific theories, ideas, methodologies and the newest technologies in geothermal energy, Enhanced geothermal recovery.

Recommended Books:
2. Geothermal Energy: Utilization and Technology: by Mary H. Dickson and Mario Fanelli

**CAS-REE 509 Solar Thermal Energy [3]**


**Recommended Books:**
1. Power From The Sun, by William B. Stine and Michael Geyer.

**CAS-REE 529 Environment Impact assessment for Energy Systems [3]**

Understand the basic concepts, methodological approaches, and technological components of an Environmental Impact Assessment, Identify all applicable international Norms, National Codes and Standards concerning the environment and energy systems, Exhibit knowledge and understanding of the way that an EIA is conducted within the framework of the energy sector in Pakistan & southeast Asia

**Recommended Books:**
The world is undergoing a smooth but rapid transition from using power from fossil fuels—which are quickly depleting market demand for skilled manpower in the new, clean and available Renewable Energy resource, to fulfill its ever-growing energy demand. These sources are not only interminable, but are producing power at a lower cost compared to that from the conventional sources. Therefore, it is the need of the hour to develop competent and knowledgeable human resource to take up the transition challenges and fulfill the emerging market of energy generation and consumption.

The objectives of the Renewable Energy Engineering program is to develop capacity building in a rapidly developing knowledge and to produce graduates who can apply the knowledge and complexities. Furthermore, these sources are turning out to be appropriate technologies for the betterment of the society. These sources are not only interminable, but are producing power at a lower cost compared to that from the conventional sources. Therefore, it is the need of the hour to develop competent and knowledgeable human resource to take up the transition challenges and fulfill the emerging market of energy generation and consumption.

Mode of execution:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS-TSE 512</td>
<td>Advance Heat Transfer</td>
<td>[3]</td>
</tr>
</tbody>
</table>

**Outcomes:**

1. Graduates will be able to apply the knowledge and complexities. Furthermore, these sources are turning out to be appropriate technologies for the betterment of the society. These sources are not only interminable, but are producing power at a lower cost compared to that from the conventional sources. Therefore, it is the need of the hour to develop competent and knowledgeable human resource to take up the transition challenges and fulfill the emerging market of energy generation and consumption.

**Objective:**

The objectives of the Renewable Energy Engineering program is to develop capacity building in a rapidly developing knowledge and to produce graduates who can apply the knowledge and complexities. Furthermore, these sources are turning out to be appropriate technologies for the betterment of the society. These sources are not only interminable, but are producing power at a lower cost compared to that from the conventional sources. Therefore, it is the need of the hour to develop competent and knowledgeable human resource to take up the transition challenges and fulfill the emerging market of energy generation and consumption.

**Recommended Books:**

3. *Computational Methods for Heat and Mass Transfer.* By Pradip Majumdar, Pradip Majumdar
M.Sc. & Ph.D. in Renewable Energy Engineering

The world is undergoing a smooth but rapid transition from producing power from fossil fuels – which are quickly depleting and pose serious environmental threats – to more abundantly available Renewable Energy resource, to fulfill its ever growing energy demand. These sources are not only interminable, but are also environment friendly. These sources provide opportunity for promoting distributed power generation to avoid power transmission and distribution losses and other associated complexities. Furthermore, these sources are turning out to be more economical, and in many instances the costs of power generation from these sources is cheaper compared to that from the conventional sources. Therefore, it is the need of the hour to develop competent and knowledgeable human resource to take up the transition challenges and fulfill the emerging market demands for skilled workforce in these areas. Pakistan is blessed with abundant solar, wind, hyrdo and biomass resource, and thus it can easily fulfill its growing energy demands if these sources are properly harnessed. With these objectives in mind, USPCAS-E UET Peshawar would like to commence Master and Ph.D. programs in Renewable Energy Engineering as per the course curriculum below.

Objectives:
The objectives of the Renewable Energy Engineering program is to develop capacity building in a rapidly developing knowledge bank for addressing the ever rising demand for energy through modern renewable technologies. This objective is to be achieved through continuously updating the course curriculum of the program to ensure relevance to the latest market demands and generation of new technologies, as well as encouraging professional growth and development of the students and researchers. The program is designed to satisfy the growing market demand for skilled manpower in the new, clean and economical energy sources.

Mode of execution: The courses are offered in regular day classes, conducted at the campus. It will also include industrial visits, seminars, training modules and case studies.

Outcomes:
1. Graduates will be able to apply the knowledge and principles of renewable energy engineering and use appropriate technologies for the betterment of the society.
2. Recognize international and national issues related to global warming and environmental degradation, in respect of energy generation and consumption.
3. Solve problems by thinking critically, creatively and reflectively and communicate solutions in an effective manner.
4. Apply the science and engineering principles for solving the energy related issues specific to Pakistan and other developing countries.
5. Select and apply appropriate techniques, resources and modern engineering tools, including prediction and modeling, to design, analyze and experimentally verify the renewable energy systems and their components output.
6. Apply international standards, practices and conventions appropriate to energy policies, like Kyoto protocol and Paris agreements.
7. Understand the impact of renewable energy solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.


**Criteria and Requirements**

**Criteria and Requirements for M.Sc. in Renewable Energy Engineering**

**Eligibility Criteria:**
- B.Sc. in Mechanical Engineering
- B.Sc. in Chemical Engineering
- B.Sc. in Electrical Engineering
- B.Sc. in Mechatronics Engineering
- B.Sc. in Material Engineering
- B.Sc. in Agricultural Engineering
- Or any other relevant B.SC. Engineering degree

**Degree Requirement:** MS Program would comprise of 32 Credit Hours in both Core and Elective Courses, as well as the thesis.

**Seat Allocation:** Seat allocation (per semester) for Master of Science (M.Sc.) in Renewable Energy Engineering: 25 seats with 50% allocation for female candidates as per requirement of USAID. Female candidates must fulfill the university criteria for admission in M.Sc. Program.

**Eligibility Criteria for Ph.D. in Renewable Energy Engineering**

- M.Sc. in Mechanical Engineering
- M.Sc. in Chemical Engineering
- M.Sc. in Electrical Engineering
- M.Sc. in Mechatronics Engineering
- M.Sc. in Material Engineering
- M.Sc. in Renewable Energy Engineering
- M.Sc. in Agricultural Engineering
- Or any other relevant M.S./M.Sc../M.Phil Engineering degree with a minimum CGPA of 3.0

Students will be offered admission as per standard Ph.D. admission policy of UET.

**Degree Requirement:** Ph.D. Program would comprise of at least 54 credit hours, out of which at least 18 credit hours (including 12 credit hours of core courses) should be in the form of course work with a minimum CGPA of 3.3. All other existing rules of UET-Peshawar will be followed in this regard. The following breakup of credit hours will be used:

**Seat Allocation:** As per USPCAS-E UET(Peshawar) policy

**Core Courses**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Cr. Hrs</th>
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</thead>
<tbody>
<tr>
<td>CAS-REE 501</td>
<td>Renewable Energy Technologies</td>
<td>3</td>
</tr>
<tr>
<td>CAS-REE 502</td>
<td>National/Provincial Energy Policies, Supply/Demand &amp; Planning</td>
<td>3</td>
</tr>
<tr>
<td>CAS-REE 503</td>
<td>Management of Technology &amp; Innovation</td>
<td>3</td>
</tr>
<tr>
<td>CAS-REE 504</td>
<td>Power Electronics and Machines</td>
<td>3</td>
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</table>
Elective Course Options

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Cr. Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS-REE 502</td>
<td>Energy Quality management and Standards</td>
<td>3</td>
</tr>
<tr>
<td>CAS-REE 503</td>
<td>Energy Audit and Planning</td>
<td>3</td>
</tr>
<tr>
<td>CAS-REE 504</td>
<td>Envir. Impact Assessment for Energy Systems</td>
<td>3</td>
</tr>
<tr>
<td>CAS-REE 505</td>
<td>Development &amp; Evaluation of RE Projects</td>
<td>3</td>
</tr>
<tr>
<td>CAS-REE 506</td>
<td>First Year Thesis</td>
<td>6</td>
</tr>
<tr>
<td>CAS-REE 507</td>
<td>CFD for Renewable Energy</td>
<td>3</td>
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<tr>
<td>CAS-REE 508</td>
<td>Wind Energy Engineering</td>
<td>3</td>
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<tr>
<td>CAS-REE 509</td>
<td>Solar Thermal Energy</td>
<td>3</td>
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<tr>
<td>CAS-REE 510</td>
<td>Hydro Power Engineering</td>
<td>3</td>
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<tr>
<td>CAS-REE 511</td>
<td>Biomass Technologies</td>
<td>3</td>
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<tr>
<td>CAS-REE 512</td>
<td>Geothermal Engineering</td>
<td>3</td>
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<tr>
<td>CAS-REE 513</td>
<td>Applied Photovoltaics Engineering</td>
<td>3</td>
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<tr>
<td>CAS-REE 514</td>
<td>Renewable Energy Mega Power plants</td>
<td>3</td>
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<tr>
<td>CAS-REE 515</td>
<td>Advanced topics in Renewable Energy</td>
<td>3</td>
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<tr>
<td>CAS-REE 516</td>
<td>Electrical and Optical Properties of Materials</td>
<td>3</td>
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<tr>
<td>CAS-REE 517</td>
<td>Materials Characterization Techniques</td>
<td>3</td>
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<tr>
<td>CAS-REE 518</td>
<td>Adv. Topics in Energy Storage &amp; Conversion</td>
<td>3</td>
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<tr>
<td>CAS-REE 520</td>
<td>Operation &amp; Maintenance of RE Systems</td>
<td>3</td>
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<tr>
<td>CAS-REE 522</td>
<td>Research Methodology</td>
<td>3</td>
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<tr>
<td>CAS-REE 523</td>
<td>Risk and Reliability Engineering</td>
<td>3</td>
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<tr>
<td>CAS-REE 524</td>
<td>Energy &amp; Environment</td>
<td>3</td>
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<tr>
<td>CAS-REE 525</td>
<td>Environment and Energy</td>
<td>3</td>
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<tr>
<td>CAS-REE 526</td>
<td>Electromagnetic Energy Conversion</td>
<td>3</td>
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<tr>
<td>CAS-REE 527</td>
<td>Electro-chemical Energy Conversion</td>
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<tr>
<td>CAS-REE 529</td>
<td>Recommendation Books</td>
<td>3</td>
</tr>
<tr>
<td>CAS-REE 530</td>
<td>Development &amp; Evaluation of RE Projects</td>
<td>3</td>
</tr>
</tbody>
</table>

Catalog Course Descriptions:

**M.Sc. & Ph.D in Renewable Energy Engineering (REE)**

**Core Courses**

**CAS-REE 501 Renewable Energy Technologies [3]**


**Recommended Books:**

2. Power From The Sun, by William B. Stine and Michael Geyer

**CAS-REE 502 National/ Provincial Energy Policies, Supply/Demand & Planning**

Topics include (a) demand side planning (methods of demand projection, demand management and fuel substitutions), (b) supply side planning (methods of estimation of energy supplies from indigenous resources, supply side policies and strategies etc.) (c) Financial planning (assessment of quantum of financial resources required and affordability of the investment including (macro and micro economic impacts, mobilization of financial resources including from private sector). New modern approaches like the Shale boom, exploitation of Marginal & low economic resources with ultimate energy sources will be deliberated to bring these into the main stream. Global, regional, national and provincial supply/demand scenarios will be developed. The course shall include Case Study for Provincial Setup, capacity building, infrastructure, status, policy regimes, international geopolitical energy scenario & market covering.

Recommended Books:


**CAS-REE 503 Management of Technology & Innovation**

Project management (Scope definition, Planning and Scheduling, Critical path analysis), People management (Understanding yourself, Understanding other people, Working in teams, Dealing with conflicts), Marketing (Marketing technology, Selling technology, Market segmentation), Negotiation (Preparation for negotiations, Negotiation process, Win-win Solutions), New product development (Commercializing technology, Market drivers, Time to market, Focusing technology, Concerns), Presentation skills (Understanding your audience, Focusing your message, Successful presentations, Getting your message across), Finance (Profit and loss accounts, Balance sheets, Cash flow forecasting, Project appraisal), Business game (Working in teams (companies), students will set up and run a technology company and make decisions on investment, R&D funding, operations, marketing and sales strategy), Innovative Financial & Enterprise
Recommended Text:

1. Management of Technology (The key to Competitiveness and Wealth Creation), by Tarek M. Khalil

CAS-REE 504 Power Electronics and Machines [3]
Fundamentals of Electromagnetism and Electric Power Conversion, Transformer Operations, DC Machines - motors, generators & control, AC Machines - synchronous & asynchronous, Overview of semiconductor switches - Diodes, IGBTs, MOSFETs, Boost/buck converters - operation, control and design, Multi-phase converters - operation, control and design, Switching strategies of converters, Wind generator systems: General types of electric machines. Converter types and configurations, Photovoltaic generators, PV configurations and integration, Generation Control of Isolated Power systems, Protection sys., Stability & dynamics analysis with the application of FACTS devices, Distributed Generation & Micro-Grids.

Recommended Books:

Elective Courses

CAS-REE 507 CFD for Renewable Energy [3]
The physics of thermo-fluids. Governing equations (continuity, momentum, and energy and species conservation) and state of the art Computational Fluid Dynamics including modeling, grid generation, simulation, and high performance computing. Specification for a CFD simulation exercise, Requirements for accurate analysis and validation for multi scale problems, Introduction to Turbulence and turbulent flows, Traditional and Advanced Turbulence Modeling, Introduction to Reynolds-averaged Navier Stokes (RANS) simulations and large-eddy simulation (LES), Renewable energy problems will be solved employing the widely-used industrial flow solver software FLUENT.

Recommended Books:
1. Computational Fluid Dynamics- An Introduction: Edited by John Wendt, Springer
2. Computational Fluid Dynamics – The Basics with Applications: by John Anderson, Springer
CAS-REE 508  Wind Energy Engineering  [3]


Recommended Books:
1. Wind Turbine Engineering Design, by David M. Eggleston, Van Nostrand Reinhold Company NY

CAS-REE 509  Solar Thermal Energy  [3]


Recommended Books:
1. Power From The Sun, by William B. Stine and Michael Geyer

CAS-REE 510  Hydro Power Engineering  [3]

- Hydro power potential in Pakistan, The hydrological cycle, Measurement and calculation of hydrological processes, Numerical models, Planning and design of dams in the context of hydropower development, dam engineering including concrete and embankment dams, soil mechanics for dams and concrete technology for dams, Run of the river system design, hydraulics of open channel flow,
hydraulic design of energy dissipation structures, spillways and outlets, turbines and surge tanks, hydraulic steel works and pipe hydraulics, support and lining for tunnels and caverns, engineering geological investigation methods, design approach for tunnels, caverns and pressure shafts, drill and blast tunnels, investment - socio-economic and environmental impact assessment studies with particular reference to small and micro-hydro turbines.

Recommended Books:


CAS-REE 511  Biomass Technologies [3]


Recommended Books:

3. Hydrogen and Syngas Production and Purification Technologies by Ke Liu, Chunshan Song, Velu Subramani (John Wiley & Sons) 2009

CAS-REE 512  Geothermal Engineering [3]

The course topics include geothermal power generation systems. Geothermal based heating and cooling of buildings. Geothermal exploration techniques and methods. Modeling and simulation of geothermal systems. Overall the broad objective
of this course is to introduce the energy graduates with the geothermal energy systems and how they can use geothermal energy for the power generation, building applications, and other energy related applications. And graduates will be able to display advanced understanding of relevant scientific theories, ideas, methodologies and the newest technologies in geothermal energy and enhanced geothermal recovery.

Recommended Books:
2. Geothermal Energy: Utilization and Technology: by Mary H. Dickson and Mario Fanelli

CAS-REE 515  Applied Photovoltaics Engineering [3]
The characteristics of sunlight, the behavior of solar cells, semiconductors and p-n junctions, grid-connected photovoltaic systems, stand-alone photovoltaic system design, system design for PV-powered water pumping, remote area power supply systems. Specific purpose photovoltaic applications, PV cell interconnection and module fabrication, cell properties and design. Production of commercial grade silicon from raw grade silicon, CZ, FZ process of ingot development, different type of semiconductor material and their spectral response, different type of Silicon based solar cells and their detailed study. Degradation of solar silicon based cells, System design, simulation and detailed study of BOS, batteries, Inverters, charge controllers, Applications of PV Systems.

Recommended Books:

The course deals with prospects and consequences of large scale production of renewable energy. Electromagnetic, Electrochemical, Photovoltaics, Kinetic and potential energy conversions into mass scale electrical power houses, Scale up potential of various renewable energy technologies such as solar PV, Organic Photovoltaic, CSP, thermal, Biomass energy, biofuel cell systems, and wind power house.

Recommended Books:
4. Sustainable Energy Conversion for Electricity and Coproducts: Principles technology and equipment


**CAS-REE 517 Advanced Topics in Renewable Energy [3]**

Advanced topics of current interest and trends in renewable energy engineering. Topics are selected from current technical literature: hydro energy, solar photovoltaic, solar thermal energy, biomass energy, fuel cell energy, wind energy, geothermal energy, wave & tidal energy and any other form of renewable energy.

**Recommended Books:** To be determined by the instructor

**CAS-REE 518 Electrical and Optical Properties of Materials [3]**


**Recommended Books:**

1. Electrical Properties of Materials by Laszlo Solymer, Donald Walsh, and Richard R. A. syms

**CAS-REE 519 Materials Characterization Techniques [3]**


**Recommended Books:**

CAS-REE 520  Advanced Topics in Energy Storage and Conversion [3]

Advanced topics of current interest and trends in energy storage and conversion. Topics are selected from current technical literature: fundamentals of electrochemistry, fuel cells, solar PV cells, batteries, hydrogen production and storage, super capacitors any other electrochemical devices for energy storage and conversion, wind and hydro turbines, any other electromechanical devices for energy conversion and storage, different types of heat exchangers and their role in energy conservation.

Recommended Books:  To be determined by the instructor


Types of solar cells (1st to 3rd generation), advance materials for solar cells, performance characteristics and market analysis of solar cells, different types of fuel cells, advanced materials for fuel cells, performance characteristics and market analysis of fuel cells, different types of batteries, advanced materials for batteries, performance characteristics and market analysis of batteries, advanced materials for hydro and biomass technology. Smart innovative materials for energy applications.

Recommended Books:
1. Solar Cell Materials by Conibeer & Willoughby


Condition monitoring and maintenance methods in wind turbines, Operation and maintenance methods in solar power plants, Development operation and future prospects for implementing biogas plants, Integration of renewable energy in traditional energy systems, Low cost hybrid systems of renewable energy, Control methods applied in renewable energy systems, Design for reliability of power electronics in renewable energy systems, Renewable energy systems supporting industrial applications, Use of renewable energy for smart cities, Analysis of the impact of increasing share of electric vehicles on the integration of renewable energy systems generation.

Recommended Books:
2. 5-Step: Project Operations & Maintenance, DOE Office Of Indian Energy.

CAS-EP 520 Research Methodology [3]

Define research, research terms, research process and the principle activities, relationship between
theory and research, skill development to write research thesis, assess and critique a published journal article that uses one of the primary research methods in the field, skill development for oral presentation and publishing short paper in conference proceeding, skill development for proposal writing, case studies and discussion on research trends, design of experiments and statistical analysis methods.

Recommended Books:

3. Introduction to Research Methods, by Catherine Dawson.

CAS-REE 526 Risk and Reliability Engineering [3]

Recommended Books:


CAS-REE 527 Energy Quality Management & Standards [3]
The course includes local and global quality standards in renewable energy technologies such as solar photovoltaic, solar thermal, bioenergy, and wind energy. Quality and efficiency tests, certifications, standardizations, calibration. Performance and efficiency management and sustainability related issues, PV standards, astm international, Australia—standards Australia, Canada—standards council of Canada, China—standardization administration of china, European committee for electro technical standardization (cenelec), global approval program for photovoltaics (PV gap). International systems for PV system standardization. Testing and Routes to Certification in renewable energy system. Hydrodynamic Testing, overview of facilities and techniques for testing offshore renewable energy technologies, Review of existing facilities worldwide.
and their capabilities, overview of facilities and techniques for testing wind turbine rotors, Total Quality Management (TQM), ISO 9000, Lean Manufacturing and Six Sigma components.

Recommended Books:


CAS-REE 528 Energy Audit and Planning [3]


Recommended Books:


Understand the basic concepts, methodological approaches, and technological components of an Environmental Impact Assessment, Identify all applicable international Norms, National Codes and Standards concerning the environment and energy systems, Exhibit knowledge and understanding of the way that an EIA is conducted within the framework of the energy sector in Pakistan & southeast Asia.

Recommended Books


**CAS-REE 530 Development & Evaluation of Renewable Energy Projects [3]**

Analysis of the local situation to the final energy project: what steps have to be completed in order to implement a successful regenerative energy project and what factors must be considered, Survey of energy demand; methods to collect the demand for thermal and/or electrical energy until the point of development of an energy master plan, Technology of renewable energy: how to combine the various options for using renewable energy with different supply situation in the most reasonable way?, Feasibility study, requirements and content of a feasibility study, Legal framework for plant construction (including laws pertaining to construction, water and waterways, noise, etc., Company structures; which company structure is the most appropriate for the various applications?, Risk management, Insurance, What requirements must be met in order to obtain certain types of insurance for certain renewable energy projects, Acceptance: how the acceptance of an application for the use of renewable energy can be assessed and improved?, Organization of realization of a project: how the construction phase of a renewable energy system is organized after the end of the planning period?, acceptance: Which are the acceptance steps until the regular continuous operation.

**Recommended Books:**


**CAS-REE 599** 6

**CAS-REE 699** 36
M.Sc. Energy Management & Sustainability (MSEMS)

The University of Engineering Technology UET, Peshawar, Khyber Pakhtunkhwa Pakistan pioneers a graduate degree program, namely Master of Science in Energy Management & Sustainability (MSEMS) to develop high level managerial skills in holders of professional degrees with special emphasis in Sustainability. The degree comprises of class room lectures, seminars, case studies, industrial visits, off campus professional on site problem solving activities, and optional thesis in innovative fields of power and energy management. In the MS EM & S program, participants will be given an introduction, as well as in-depth of all essential management concepts, processes, tools and techniques relevant to the Energy & Power sectors, as well as practical knowledge where the best practices in the field of energy were imparted. Case studies shall be integral part of the degree courses. Since Khyber Pakhtunkhwa has tremendous oil and gas reserves and over 40,000 MW hydro power potential therefore, the courses are designed to cater for the needs of aforementioned business areas of upstream, mid-stream and downstream. Theme of this program is to groom energy managers to manage mega-projects successfully, turnaround projects and fast track projects. The scholars shall acquire the capability to break new grounds and produce new knowledge by undertaking research work in the field of Energy Management & Sustainability, specifically for Khyber Pakhtunkhwa and generally for Pakistan.

Objectives:
MS in Energy Management & Sustainability is designed to prepare and equip future energy managers with skills to conceptualize, plan, develop, budget, finance, leverage, bid, project management, construct, commission, operate and manage mega-projects in Energy and Power Sectors.

Mode of execution:
The course is offered in evening and weekend classes. Regular as well as professional and executive training program aims at capacity building of public sector and corporate sector for policy planning and operational energy management. The course will be offered on campus instructions, visits, seminars, training modules, and case studies. Each course module may be delivered as delocalized (off campus) and on site executive training program meeting the need of client.

Learning Outcomes:
MS in EM&E is a terminal professional degree aimed to develop energy managers to manage mega-projects, equipped with the knowledge imparted in the Energy Courses, the scholars shall acquire the capability to break new grounds and produce new knowledge by undertaking research work in the field of Energy Management & Sustainability, specifically for Khyber Pakhtunkhwa and generally for Pakistan. MSEMS graduates shall pursue research work leading to the MS degree in form of a project or thesis.

Eligibility Criteria:

Degree Requirement: MS Program would comprise of 33 credit hours in both Core and Elective Course as well as thesis.

Seat Allocation: Seat allocation (per semester) for Master of Science (M.Sc.) in Energy Management and Sustainability: 25 seats with 50% allocation for female candidates as per requirement of USAID. Female candidates must fulfill the university criteria for admission in M.Sc. program.

Detail of Core Courses
12 Core Course credits required by all students enrolled in the Program.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS-EMS 501</td>
<td>Strategic Organization Management (Public/Private Sector)</td>
<td>3</td>
</tr>
<tr>
<td>CAS-EMS 502</td>
<td>Sustainable energy management and development</td>
<td>3</td>
</tr>
<tr>
<td>CAS-EMS 504</td>
<td>Management of Energy Technology &amp; Innovation</td>
<td>3</td>
</tr>
<tr>
<td>CAS-REE 516</td>
<td>Energy Quality management and Standards</td>
<td>3</td>
</tr>
<tr>
<td>CAS-EMS 601</td>
<td>Thesis Project</td>
<td>3</td>
</tr>
</tbody>
</table>

Elective Courses

Elective Courses: 14 credits

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAS-EMS 505</td>
<td>World Energy politics and supply chain analysis</td>
<td>3</td>
</tr>
<tr>
<td>CAS-EMS 506</td>
<td>Energy Tariff and Financials risk management</td>
<td>3</td>
</tr>
<tr>
<td>CAS-EMS 507</td>
<td>Energy Business Models and Marketing Strategies</td>
<td>3</td>
</tr>
<tr>
<td>CAS-EMS 508</td>
<td>Global &amp; Local Energy demand analysis</td>
<td>3</td>
</tr>
<tr>
<td>CAS-EMS 509</td>
<td>Energy Service Companies Management</td>
<td>3</td>
</tr>
<tr>
<td>CAS-EMS 510</td>
<td>Energy regulatory affairs &amp; Business Laws</td>
<td>3</td>
</tr>
<tr>
<td>CAS-EMS 511</td>
<td>Energy Project Management (Public &amp; Private)</td>
<td>3</td>
</tr>
<tr>
<td>CAS-EMS 512</td>
<td>Energy modeling, Optimization and decision making</td>
<td>3</td>
</tr>
<tr>
<td>CAS-EMS 513</td>
<td>Energy security studies</td>
<td>3</td>
</tr>
<tr>
<td>CAS-EMS 514</td>
<td>Global sustainability and international obligations</td>
<td>3</td>
</tr>
<tr>
<td>CAS-EMS 515</td>
<td>Energy environment and climate change mitigation</td>
<td>3</td>
</tr>
<tr>
<td>CAS-EMS 516</td>
<td>Energy Business Management</td>
<td>3</td>
</tr>
<tr>
<td>CAS-REE 519</td>
<td>National/Provincial Energy Planning, Policies &amp; practice</td>
<td>3</td>
</tr>
<tr>
<td>CAS-REE 515</td>
<td>Environmental Impact assessment for Energy Systems</td>
<td>3</td>
</tr>
<tr>
<td>CAS-REE 517</td>
<td>Energy Audit and Planning</td>
<td>3</td>
</tr>
<tr>
<td>CAS-EP 520</td>
<td>Research Methodology</td>
<td>3</td>
</tr>
</tbody>
</table>

Detail of Courses

CAS-EMS 501 Strategic Organization Management [3] (Public/Private Sector)

This is one of the Core Courses of MSEMS. The main objective of this Course is to enable the future energy managers to cause growth and manage public sector companies and organizations with state of the art management and solution tools & techniques. The course would have real time case studies of main public sector, change management and on high growth strategies. This course will enable the scholars to identify the key factors and elements that are
influential in the design of an organizations of the 21st Century. This course will equip the scholars with Public Sector Companies Good governance techniques, rules and risks. The course will equip the scholars with PPP mode of business and how to leverage public sector advantages to create mega-projects and investments.

Recommended Books:
2. Government as Entrepreneur by Albert N. Link, Jamie R. Link.

CAS-EMS 502 Sustainable Energy management and Development

The important role of energy in industrial, and economic development. Understand the responsible and sustainable development. Global responsibility as one world global citizen. Post fossil fuel era, ocean as energy reservoir.

Green energy approach. Consequence and prospects of resource depletions and new energy technologies.

Environmental cost of energy mega projects.

Recommended Books:

CAS-EMS 504 Management of Energy Technology & innovation
Project management (Scope definition, Planning and Scheduling, Critical path analysis), People management (Understanding yourself, Understanding other people, Working in teams, Dealing with conflicts), Marketing (Marketing technology, Selling technology, Market segmentation), Negotiation (Preparation for negotiations, Negotiation process, Win-win Solutions), New product development (Commercializing technology, Market drivers, Time to market, Focusing technology, Concerns), Presentation skills (Understanding your audience, Focusing your message, Successful presentations, Getting your message
across), Finance (Profit and loss accounts, Balance sheets, Cash flow forecasting, Project appraisal), Business game (Working in teams (companies), students will set up and run a technology company and make decisions on investment, R&D funding, operations, marketing and sales strategy), Innovative Financial & Enterprise Models for Renewable Energy Systems, Management of innovation Component.

Recommended Books:
1. The Management of Technological Innovation: Strategy and Practice by Mark Dodgson, David M. Gann, Ammon Salter

CAS-REE 516 Energy Quality Management & Standards

The course includes local and global quality standards in renewable energy technologies such as solar photovoltaic, solar thermal, bioenergy, and wind energy. Quality and efficiency tests, certifications, standardizations calibration. Performance and efficiency management and sustainability related issues. PV standards, ASTM International, Australia-standards Australia, Canada-standards council of Canada, China-standardization administration of China, European committee for electro technical standardization (Cenelec), global approval program for photovoltaics (PV gap). International systems for PV system standardization. Testing and Routes to Certification in renewable energy system. Hydrodynamic Testing, overview of facilities and techniques for testing offshore renewable energy technologies, Review of existing facilities worldwide and their capabilities, overview of facilities and techniques for testing wind turbine rotors, Total Quality Management (TQM), ISO 9000, Lean Manufacturing and Six Sigma components.

Recommended Books:

CAS-EMS 512 Energy modeling, Optimization and decision making

This course is designed to help prepare graduate students to conduct empirical research in energy and environmental economics. The course has two broad objectives. The first is to develop an in-depth understanding of specific empirical methods and research designs that are routinely used in the field of energy and environmental economics. The second is to familiarize students with some of the economic theories and institutions that are most relevant to empirical work in this area.

Recommended Books:
1. Our Fragile World: Challenges and Opportunities for
CASES 505 World Energy politics and supply chain analysis
This course will review World primary and secondary energy resources, including but not limited to oil, gas and coal resources and location of resources in various countries and regions as well as major demand centers. Various energy markets, trade routes for movement of liquid hydrocarbons (petroleum products, LPG, LNG etc.) and gas pipelines will be discussed. Roles of National Oil companies (NOCs), Provincial Oil companies (POCs) and International Oil Companies (IOC) and major oil and gas producers, including OPEC & non-OPEC will be examined. World oil, gas and coal demand supply and its impact on the fuel prices will be discussed. This course will also review future world energy outlook, the strategies being adopted to meet the future projected requirements and the lessons for the national/ provincial policy makers. Geopolitics and diplomacy will also be referred. Provinces will also be integral part & independent energy strings for both national & international sustainable energy across the globe. This course will introduce the scholars to various forms of energy, classifications of energy reserves, energy measurement units and consumption patterns. Energy balance sheets and input output models would be prepared. Scholars will also be familiarized with various energy production and conversion technologies and their future prospects (oil, gas, coal, electricity, renewable, atomic energy etc. The course will also discuss the issues in energy resources at Pakistan and global level with a view to find solution.

Recommended Books:
3. Visions for a Sustainable Energy Future by Mark A. Gabriel.

CASES 506 Energy Tariff and Financials risk management
This course shall get into details of multi-facet tariff in the power sector and oil and gas pricing. The scholars will be challenged to develop new economic concepts to ease tariff burdens on the consumers yet give fair and reasonable return on investment to sponsors. This course consists of detailed discussions on applications of economic concepts for exploitation of energy resources on one hand and delivery of energy products on the other hand at both macro and micro level. These discussions will be based on real life examples of Pakistan economy and global energy dynamics. The topics will include micro economic foundation of energy demands and supply; regression analysis, elasticity of demand curve fitting techniques for future energy projection; economic allocation of energy resources and pricing issues; macro economic linkages of energy delivering system etc. It will also include discussion more so in the context of Pakistan's experience on the energy market structure, vertical
integrated utilities, emerging concepts of unbundled utilities and fair and open competition in the energy market. Some regulatory issues and experience of Pakistan's energy regulatory bodies will be discussed in the context of determination of prices of electricity, oil and gas.

**Recommended Text:**

1. Electricity Pricing in Transition by Ahmad Faruqui.

**CAS-EMS 507 Energy Business Models & Marketing Strategies**

The course will enable the scholars to capitalize on the opportunities with limited resources to achieve a sustainable competitive advantage. And also assist them to select a course of action from among several alternatives that involves specific customer groups, communication methods, distribution channels and pricing structures. Great emphasis will be on marketing the oil & gas reserves and Hydro potential of Khyber Pakhtunkhwa to prospective buyers and sponsors in other part of the country. A marginal cost mechanism will be discussed to give fair and reasonable marketing tools to the Government of Khyber Pakhtunkhwa. Various marketing tools and techniques will be examined, as well.

**Recommended Books:**

1. Alexander Osterwalder, Yves Pigneur

**CAS-EMS 508 Global & Local Energy demand analysis**

Importance of supply/demand balance for sustainable energy ecology.

- Local need analysis from house hold consumer to corporate energy users.
- Global energy demand past, present and future.
- End user energy conservation as global responsibility.
- Economic impact of energy conservation and efficiency from domestic to corporate buildings.
- Energy conservation and efficiency by green building approach.

**Recommended Books:**

2. Energy beyond oil by Fraser Armstrong, Katherine Blundell.
CAS-EMS 509 Energy service companies management [3]

Energy crises and security issue took a heavy toll on the economy of Pakistan. The objective of this course is economy renaissance, especially in the energy, industrial and services sectors. Revival and turnaround of the economy through energy is one of the most important aspect of Pakistan, especially Khyber Pakhtunkhwa.

Topics will include, the concept of strategic management, building competitive advantage by examining internal and external factors (current and forecast), making functional, corporate and global strategies, vertical integration, diversification, corporate restructuring and unbundling, mergers and acquisitions, organizational development and control, governmental and corporate leadership. The high capex and opex is perhaps one of the largest deterrent that has made IRR of public and private sectors feasibilities below the Discount Rate.

The scholars shall develop ways and means in interactive discussions to achieve the purpose of the course. High profile experts will be invited to interact with the scholars and share their experience in revival. This course will have case studies on how businesses made a turnaround. The purpose of this course is to generate out of the box and innovative ideas amongst the scholars. International research on turnarounds will be examined minutely in the Course.

CAS-EMS 511 Energy Project Magmt. (Public & Private) [3]

This course will present the theory and practices in Energy project management, especially mega-projects. Topics will included but not limited to project EOI, Pre-Qualification, tenders, RFP, bidding, PPRA, KPPRA, PEC, FIDIC, planning, scheduling, execution, budgeting, Working Capital, catch up plan. Case studies will also be included. Major software used in the project management will be discussed. National and international rules governing tenders will also be discussed.

The purpose of the course is to enable the scholars to understand and analyze the project management and organizational processes and strategies. The focus is on scholarly research in the field of management and organizational theory and design. The course emphasizes on the emerging issues of project management, management research, leadership styles, organizational design, policy formulation and strategic thinking. The ultimate goal is to evolve the critical thinking among scholars so that they can analyze the existing literature on project management focused on the indigenous project management organizational problems should significantly contribute to the existing body of scientific knowledge of project management.

Khyber Pakhtunkhwa does need involvement of the public sector to sustain the economy. This course will present the theory and practices in Energy project management, especially public mega-projects. Topics will included but not limited to project EOI, Pre-Qualification, tenders, RFP, bidding, PPRA, KPPRA, PEC, FIDIC, planning, scheduling, execution, budgeting, Working Capital, catch up plan. Case studies will also be included. Major software used in the project
management will be discussed. National and international rules governing tenders will also be discussed.

Recommended Books:

1. Government as Entrepreneur by Albert N. Link, Jamie R. Link.

CAS-EMS 510 Energy regulatory affairs & Business Laws

It is important for the energy managers to know Energy and Business laws, especially those in the Public Sector. The course will give live examples of various Acts and Rules, including Companies Act 1954, Petroleum Policies, Petroleum Rules, Power Policies, KKPRA Rules, PPRA Rules, RFP policies etc. A few case studies will be examined in the class under interactive mode. The scholars will be required to propose changes in various laws and rules to make these efficient and bring these in line with investor friendly environment. Laws and rules of other countries will also be examined and compared with that of Pakistan.

Recommended Books:


CAS-EMS 515 Energy environment & climate change mitigation


Recommended Books:


CAS-EMS 513 Energy security studies

Economic indicators of energy inflation and crises.

Energy crises: Pakistan case study

Recommended Books:

CAS-EMS 514 Global sustainability and international obligations
Understand the responsible and sustainable development.
Global responsibility as one world global citizen.
Post fossil fuel era, ocean as energy reservoir.
Green energy approach. Consequence and prospects of resource depletions and new energy technologies.
Identify all applicable international Norms, protocols, UN conventions, environmental cost of energy mega projects.

Recommended Books:

CAS-EMS 516 Energy Business Management
This course is an extension of MSEMS-703. Pakistan's economy is burdened with heavy expenditure on ex-pats not only during the planning and construction phases but also during operation and maintenance phases. The high capex and opex is perhaps one of the largest deterrent that has made IRR of public and private sectors feasibilities below the Discount Rate. This Course is designed to encourage and impart skills, tools and techniques to national scholars to establish their own ESCOs under low risk profile. The mini/micro hydel is one great example that will be taught in the class and interacted with PEDO so that scholars can do businesses on planning, construction and O&M in remote areas. The scholars can also interact with venture capital markets to sell their knowledge and skills. Case studies will be integral part of the course work.

Recommended Books:
2. Entrepreneurs and Innovation: Creating Value with Emerging Technologies by Keith Herndon.


CAS-REE 517 Energy Audit and Planning [3]


Recommended Books:


CAS-REE 515 Environment Impact assessment [3]

for Energy Systems

Understand the basic concepts, methodological approaches, and technological components of an Environmental Impact Assessment, Identify all applicable international Norms, National Codes and Standards concerning the environment and energy systems, Exhibit knowledge and understanding of the way that an EIA is conducted within the framework of the energy sector in Pakistan & southeast Asia

Recommended Text:


3. Visions for a Sustainable Energy Future by Mark A. Gabriel.

CAS-REE 519 National/Provincial Energy planning, Policies & Practice [3]

Topics include (a) demand side planning (methods of demand projection, demand management and fuel substitutions), (b) supply side planning (methods of estimation of energy supplies from indigenous resources, supply side policies and strategies etc.) (c) Financial planning (assessment of quantum of financial resources required and affordability of the investment including (macro and micro economic impacts, mobilization of financial resources including from private sector). New modern approaches like the Shale...
boom, exploitation of Marginal & low economic resources with ultimate energy sources will be deliberated to bring these into the main stream. Global, regional, national and provincial supply/demand scenarios will be developed. The course shall include Case Study for Provincial Setup, capacity building, infrastructure, status, policy regimes, international geopolitical energy scenario & market covering.

Recommended Text:


Recommended Text:
3. Introduction to Research Methods, by Catherine Dawson.

CAS-EP 520 Research Methodology [3]

Define research, research terms, research process and the principle activities, relationship between theory and research, skill development to write research thesis, assess and critique a published journal article that uses one of the primary research methods in the field, skill development for oral presentation and publishing short paper in conference proceeding, skill development for proposal writing, case studies and discussion on research trends, design of experiments and statistical analysis methods.
Board of Advanced Studies and Research (BOASAR)

The Board of Advanced Studies and Research (BOASAR) was instituted as one of the authorities of the University under section 13(V) of the university ordinance. Its functions include:

- To advise the authorities on all matters connected with the promotion of advanced studies and research in the University.
- To consider and report to the authorities on the institution of research degrees in the university.
- To propose regulations regarding the award of research degrees.
- To appoint supervisors for research students and to determine the subject of their thesis.
- To receive research projects from university teachers.
- To sanction research grants against specific research projects.
- To coordinate and approve research programme and budget.
- To monitor faculty research.
- To utilize research results.

Masters and Ph.D. degree programmes in selected departments are being run under the umbrella of BOASAR. Funds are provided for both faculty research and student research. Postgraduate Advisors have been appointed for each specialization to provide guidance and assistance to researchers. BOASAR also maintains regular contact with local industry and the government to help solve their technological problems.

Best Applied Research Project Award

To support and encourage faculty research in the university, an award has been instituted for the best applied research project. Principal Investigators of approved projects may apply for the award, which includes a cash award as well as a certificate and shield. Full details, including eligibility, application procedure, award criteria and details of award are available at the BOASAR office for reference.
Rules & Regulations

Master Degree Programme

GENERAL
The Master's degree programme at University of Engineering and Technology shall extend over a period of at least four semesters. A total of 33 credit hours (including 27 credit hours of courses and 6 credit hours of research) are required to complete the Master's Degree Programme. The 27 credit hours of course work shall include a minimum of 18 credit hours from the area of specialization and 3 credit hours of the course "Research Methodology". This course will be registered as a credit course.

RULES
1.1 Admission

a) Master's degree programme shall commence in Spring and Fall semesters i.e, twice annually.

b) Candidates seeking admission must have a Bachelor's Degree in a relevant Engineering discipline from an institution accredited by Pakistan Engineering Council or Sixteen (16) years of education for Non-Engineering disciplines from an institution recognized by HEC.

c) Candidates seeking admission must score 50% minimum marks in GRE International type test or GAT (General) organized by University Appointed Testing Authority (UATA).

d) Applications on the prescribed form shall be made to the Director Admissions, on the date advertised in newspapers, after which no application shall be entertained.

e) Seats for Pakistani students are given in Table-1 page-02. 50% of the total allocated seats in each category will be filled during Fall semester, and remaining will be filled during Spring semester.

f) Candidates shall have to pass departmental subject and UATA test with at least 50% marks. Final merit shall be made based on the combined results of UATA marks and the departmental test in the following manner:

GRE International / GAT (General) Test conducted by UATA = 50% weightage.
Departmental Subject Test = 50 % Weightage

g) The UATA (GAT General)/UATA (UET GAT Special) tests shall be valid for one academic year (two semesters i.e Spring & Fall or Fall & Spring) while subject test shall be conducted each time admission is offered.
Table 1: Seat allocation for Pakistani students for Fall 2018 Semester and Spring 2019 Semester

<table>
<thead>
<tr>
<th>Department</th>
<th>Seats Reserved for Open Merit</th>
<th>Seats Reserved for Rationalized Fees Basis</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Engineering</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Engineering</td>
<td>30</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>Communication and Electronic Engineering</td>
<td>35</td>
<td>10</td>
<td>45</td>
</tr>
<tr>
<td>Civil Engineering</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Resources Engineering</td>
<td>22</td>
<td>10</td>
<td>32</td>
</tr>
<tr>
<td>Environmental Engineering</td>
<td>22</td>
<td>10</td>
<td>32</td>
</tr>
<tr>
<td>Structural Engineering</td>
<td>25</td>
<td>10</td>
<td>35</td>
</tr>
<tr>
<td>Geo-Technical Engineering</td>
<td>23</td>
<td>10</td>
<td>33</td>
</tr>
<tr>
<td>Transportation Engineering</td>
<td>23</td>
<td>10</td>
<td>33</td>
</tr>
<tr>
<td>Earthquake Engineering</td>
<td>20</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamics &amp; Control</td>
<td>25</td>
<td>10</td>
<td>35</td>
</tr>
<tr>
<td>Mechanical Engineering Design</td>
<td>30</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>Materials Engineering</td>
<td>20</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>Computer Systems Engineering</td>
<td>35</td>
<td>10</td>
<td>45</td>
</tr>
<tr>
<td>Mining Engineering</td>
<td>20</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>Agricultural Engineering</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil &amp; Water Engineering</td>
<td>20</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>Farm Machinery &amp; Power Engineering</td>
<td>15</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Chemical Engineering</td>
<td>25</td>
<td>10</td>
<td>35</td>
</tr>
<tr>
<td>Industrial Engineering</td>
<td>35</td>
<td>10</td>
<td>45</td>
</tr>
<tr>
<td>Computer Software Engineering</td>
<td>35</td>
<td>10</td>
<td>45</td>
</tr>
<tr>
<td>National Institute of Urban Infrastructure Planning (NIUIP)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban Infrastructure Engineering Degree Programme</td>
<td>30</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>Urban Infrastructure Planning &amp; Management</td>
<td>25</td>
<td>10</td>
<td>35</td>
</tr>
<tr>
<td>Mathematics</td>
<td>35</td>
<td>10</td>
<td>45</td>
</tr>
<tr>
<td>Computer Science &amp; Information Technology (CS&amp;IT)</td>
<td>35</td>
<td>10</td>
<td>45</td>
</tr>
<tr>
<td>Mechatronics Engineering</td>
<td>35</td>
<td>20</td>
<td>55</td>
</tr>
<tr>
<td>Telecommunication Engineering</td>
<td>35</td>
<td>10</td>
<td>45</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>655</strong></td>
<td><strong>260</strong></td>
<td><strong>915</strong></td>
</tr>
</tbody>
</table>
Note: Exact number of open merit seats as per semester quota will be offered in each semester. Furthermore if an open merit seat remains vacant in Fall semester then it shall be added to the quota of open merit seats to be offered in Spring semester.

h) On the recommendations of the Admission Committee, the vice-chancellor shall approve the names of candidates selected for admission.

i) A candidate’s admission shall be confirmed after he/she has deposited the prescribed fees with the University within the period specified for this purpose.

j) No student shall be admitted after two weeks of the start of classes.

k) The Director Postgraduate Studies shall forward the particulars of each student admitted for the first time, within 15 days of the completion of admission to the Controller of Examinations. The Controller shall assign a registration number to each student, if not already registered with UET.

l) Admission of any student is liable to be cancelled if his/her academic progress or conduct at any stage is found unsatisfactory.

m) Students registered for Master’s programme shall not be allowed to participate in various students’ organizations.

n) The facility of hostel accommodation for Master’s students shall be provided on need basis, subject to availability.

o) If any of the particulars given by the candidate in his/her application are found incorrect or facts are suppressed, he/she shall be denied admission. If any incorrect or false statement or suppression of facts is detected after a candidate has been granted admission, his/her admission shall be cancelled and he/she shall be expelled from the University at any time during the course of his/her studies.

p) A candidate who is already a bonafide, full time student of some other institution, is ineligible to take admission in this University. He/She will have to cancel admission in other University before taking admission in UET, Peshawar. A student may take admission in other university subject to cancellation and clearance of his/her dues. If a case is detected where a student enrolled in this University is also a student of some other institution, his/her admission in the University shall be cancelled.

q) At the time of admission, selected candidates shall submit an undertaking to abide by the Rules and Regulations prevailing in the University. This shall be according to the prescribed proforma on non-judicial Stamp Paper worth Rs.50/-, and duly attested by an Oath Commissioner.

r) In the event of a tie of aggregate marks (UATA+Departmental Subject Test) between two or more candidates seeking admission in the
Master's Programme, the subject test marks will be considered. In case these are equal then older candidate shall be considered.

1.1.1 Admission of Foreign Students

a) The applications of foreign students must be routed through the Director, Academics, Higher Education Commission, Sector H-9, Islamabad (www.hec.gov.pk/fsadm). All applicants of this category should submit, along with their application forms:

(i) A certificate showing proficiency in English language, e.g. TOEFL or IELTS with a minimum score of 50%.

(ii) A financial statement confirming the availability of funds for completing the Master's Degree programme.

b) Foreign students seeking residential accommodation at the University Campus may apply to the Provost, University Hostels.

c) Foreign students are exempted from entrance test for admission.

d) Twenty Four (24) floating seats are reserved for foreign students in the Postgraduate Programme.

1.2 Academic Advisor

Any faculty member with at least Master's degree in the relevant field shall be appointed as the Academic Advisor.

1.3 Postgraduate Advisors

Each specialization of the Department concerned will have a Postgraduate Advisor having Ph.D. Degree, who will work under the direct supervision of the Chairman. The advisor will monitor the implementation of the postgraduate programme in his/her department, and maintain liaison with the BOASAR (Board of Advance Studies and Research) Secretariat. His duties will include:

a) Providing guidance to students on rules and regulations of the Master's Degree Programme.

b) Providing guidance to students on selection of research projects.

c) Organizing field trips of Master's students.

d) Promoting links with industries and other outside organizations.

e) Promoting faculty research.

f) Organizing extension lectures, seminars, workshops and training courses in the departments.

g) Supervising reference library in the department.
Master Degree Programme

h) Coordinating with the Academic Advisor of Master's students on various issues, such as registration, selection of courses and general programme of study.

1.4 University Fees

University fees for postgraduate students enrolled on open merit seats are shown in Table 2.

Table 2: University Fees for Postgraduate Students on Open Merit.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Item</th>
<th>Pakistani Nationals (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Registration Fees (per semester)</td>
<td>2000.00</td>
</tr>
<tr>
<td>2</td>
<td>Tuition Fee (per credit hours)</td>
<td>3000.00</td>
</tr>
<tr>
<td>3</td>
<td>Computer Fund (per semester)</td>
<td>750.00</td>
</tr>
<tr>
<td>4</td>
<td>Library Fund Non Refundable (per semester)</td>
<td>1000.00</td>
</tr>
<tr>
<td>5</td>
<td>Library &amp; Lab. Security (on first registration) Refundable</td>
<td>4000.00</td>
</tr>
<tr>
<td>6</td>
<td>Field Trips (Charged when a field Trip organize)</td>
<td>1000.00</td>
</tr>
<tr>
<td>7</td>
<td>Thesis Evaluation Charges (on submission of Thesis)</td>
<td>4000.00</td>
</tr>
<tr>
<td>8</td>
<td>Course Completion Certificate</td>
<td>200.00</td>
</tr>
<tr>
<td>9</td>
<td>Interim Transcript</td>
<td>200.00</td>
</tr>
<tr>
<td>10</td>
<td>Final Transcript</td>
<td>500.00</td>
</tr>
<tr>
<td>11</td>
<td>Lab. Charges (per Semester)</td>
<td>2000.00</td>
</tr>
<tr>
<td>12</td>
<td>Internet Charges (per semester)</td>
<td>1000.00</td>
</tr>
<tr>
<td>13</td>
<td>CMS/PERN Charges (per semester)</td>
<td>2000.00</td>
</tr>
<tr>
<td>14</td>
<td>Utility charges (per semester )</td>
<td>2000.00</td>
</tr>
</tbody>
</table>

Three subjects (9 credit hours) tuition fee will be paid at the time of admission in addition to registration fee in first semester.
Fees for a semester are payable at the beginning of each semester, on the date of registration. In case of Admission Cancellation the refund policy is as under:

<table>
<thead>
<tr>
<th>% of Tuition Fee</th>
<th>Time Line for Semester System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full (100%) Fee refund</td>
<td>Upto 7th day of commencement of classes</td>
</tr>
<tr>
<td>Half (50%) Fee refund</td>
<td>From 8th-15th day of commencement of classes</td>
</tr>
<tr>
<td>No Fee (0%) refund</td>
<td>From 16th day of commencement of classes</td>
</tr>
</tbody>
</table>

Late fee of Rs.200/- per day (maximum upto Rs.1,800/-) will be charged from the students who failed to deposit the University dues/funds within due date for any reason.

1.5 Registration

a) At the beginning of each semester, students shall register for courses in consultation with the departmental Academic Advisors.

b) List of courses offered in a Department shall be finalized by Postgraduate Advisor of the relevant field of specialization, in consultation with Academic Advisors, and this shall be displayed on the postgraduate notice board, one week before registration, to facilitate students in choosing courses.

c) Minimum number of students to register for a course shall be five for all the Departments, otherwise, the course shall be dropped for that semester. In case a course is dropped by the Department, the fees shall be refunded to the students or adjusted in the coming semesters. However, the departments can offer course(s) to a class having less than five students in exceptional cases with the approval of Dean. A department can also offer course(s) to students relevant to M.Sc Thesis in the area of research.

d) To ensure quality of teaching the maximum number of students in each section of Postgraduate course should not be more than 20. If the number of registered students in any subject exceeds 20, then they shall be accommodated in more than one section.

e) A student who wants to freeze a semester shall have to register in a “Zero Semester” subject to the following conditions:

i. He/She will pay registration fee for the “Zero Semester”

ii. He/She will apply within 15 days of start of the classes

iii. He/She will be allowed to clear his/her subjects prior to “Zero Semester”

iv. He/She can resume his/her studies in a given semester subject to the approval of the Chairman.

1.6 Work Study Load

A student shall not be allowed to take more than three courses per semester.
1.7 Addition of Courses/Withdrawal from Courses

a) A student may be allowed to add/drop courses within two weeks of the beginning of classes.
b) A student may be allowed to withdraw from courses within six weeks of commencement of classes by applying on the prescribed proforma. A grade of 'W' will be reported in that case.
c) Fees shall not be refunded to a student who withdraws from a course. However, if a course is dropped by UET, fees shall be refunded to student(s).
d) In case a student fails to apply for withdrawal from a course and remains absent, F Grade will be awarded.

1.8 Class Work and Attendance

A student shall attend the classes regularly, submit assignments in time, and appear for tests and examinations when announced by the teacher. Candidates with less than 75% attendance in a course shall not be allowed to appear in the final examination of the course.

1.9 Examination

1.9.1 Course Work

a) For all taught courses of M.Sc Programme, a final term examination having 50% weightage must be carried out. The remaining 50% marks can be distributed over quizzes, home assignments, mid term examination, mini projects etc, or any other appropriate way, as it suits the requirement of the course. However, such distribution should be clearly spelt out in writing before the commencement of the course and be submitted to the Postgraduate Advisor of the respective departments.

1.9.2 Research work

a) The M.Sc research proposal (submitted by a student at the end of second semester of his/her Postgraduate Studies) shall be initially vetted by Project Research Evaluation Committee (PREC), formally constituted for each specialization in each discipline before recommending it to the BOASAR office for final approval. The chairman of the department concerned will recommend the names of three faculty members (including Postgraduate Advisor) holding Ph.D. degrees for constitution of PREC for approval of the Vice Chancellor through Secretary (BOASAR). The Chairman of the concerned department will act as a convenor of the PREC. The PREC will be reconstituted after a period of one year. The Chairman of the concerned department may recommend a Ph.D faculty member, expert in the relevant area, to act as member (co-opted) for the PREC.
b) All M.Sc students working on their research will give at least one seminar to PREC at the end of each semester.
c) Before a student is allowed to defend his/her thesis, it will be vetted by the university against
plagiarism. For the award of M.Sc degree, at least one paper should be published from the M.Sc research thesis in a refereed national/ international conference or journal.

d) The maximum number of postgraduate students under a Research Supervisor shall be twelve (12) which will include maximum five (05) Ph.D students.

1.9.2.1 Examination of Research Work

The examination of the research work of the candidate shall be conducted by an Examination Committee comprising (1) Internal Examiner, (2) Student’s Research Supervisor and (3) External Examiner from outside the University. The Examination Committee will be appointed by the vice-chancellor on the recommendation of the Dean. The Supervisor shall act as the Chairman of the Examination Committee. The examination shall include:

(i) Evaluation of thesis
(ii) Viva-voce examination

If the thesis is judged as adequate, the candidate shall appear in the viva-voce examination to be conducted by the Examination Committee on a specific date. The thesis supervisor must inform the Director Postgraduate Studies about the Thesis Defense Examination Result on the official form T-3. If the thesis is found inadequate, it may be referred back for revision and resubmission within a specified period as detailed by the Examination Committee. Only one chance of resubmission shall be allowed to a candidate and if the revised thesis is not approved under the aforesaid procedure, the thesis shall be rejected. In a case of revised thesis resubmitted for evaluation, the student has to pay thesis evaluation charges again. If in the opinion of the majority of the examiners, the candidate fails in the oral examination, he/she may be permitted to reappear in the viva-voce re-examination within a period of three months. In such a case the candidate shall be given only one chance to re-appear in the oral examination.

1.10 Quality of Work (Grades)

a) To be eligible for graduation, a student must have a CGPA of at least 2.67 (B-) in course work and satisfactory grade (S) in research. Grade Points are assigned as shown in Table 3.

Table 3: Grade Points

<table>
<thead>
<tr>
<th>Grade</th>
<th>Grade Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4.00</td>
</tr>
<tr>
<td>A-</td>
<td>3.67</td>
</tr>
<tr>
<td>B+</td>
<td>3.33</td>
</tr>
<tr>
<td>B</td>
<td>3.00</td>
</tr>
<tr>
<td>B-</td>
<td>2.67</td>
</tr>
<tr>
<td>C+</td>
<td>2.33</td>
</tr>
<tr>
<td>C</td>
<td>2.00</td>
</tr>
<tr>
<td>C-</td>
<td>1.67</td>
</tr>
<tr>
<td>D+</td>
<td>1.33</td>
</tr>
<tr>
<td>D</td>
<td>1.00</td>
</tr>
<tr>
<td>F</td>
<td>0.00</td>
</tr>
<tr>
<td>I</td>
<td>Incomplete</td>
</tr>
<tr>
<td>W</td>
<td>Withdrawn</td>
</tr>
<tr>
<td>N</td>
<td>Audit</td>
</tr>
<tr>
<td>S</td>
<td>Satisfactory (for thesis only)</td>
</tr>
<tr>
<td>U</td>
<td>Unsatisfactory (for thesis only)</td>
</tr>
</tbody>
</table>
b) A student who has been awarded "F" grade in a course may be allowed one chance to improve the grade by repeating the course within the prescribed time limit (see.1.13-e). This facility may be availed for a maximum of two courses during the entire Master's programme. Only the higher grade will be used in computing the GPA.

c) Grade "I" (incomplete) is awarded to a student only if he/she has missed the Final Examination, Project Report, etc. due to genuine reasons, but has completed all the other work of the course successfully. Grade "I" should be converted to an appropriate letter grade within two consecutive semesters, otherwise it would be converted into Grade "F" permanently.

d) The requirement of a "N" grade would be laid down by the teacher of a course at the beginning of the semester.

e) The Grade Point Average (GPA) will be calculated as follows:

   Quality Points of each course = Grade Points of grade awarded x Course credit hours.

   GPA = Sum of Quality Points of all courses / Total credit hours

f) Improvement of grade "C" and below:

   Students taking grade "C" or a lower grade than "C" will get only one chance to improve the grade by repeating the course. Tuition fees will be charged for repeating the course. The student will get no additional credit for repeating the course. After repeating the course and fulfilling all its requirements including exams, the instructor concerned will award the student a fresh grade.

1.11 Medium of Instruction

The medium of instruction in all Postgraduate Courses shall be English. Foreign students will be required to satisfy the concerned department about their proficiency in English before registration.

1.12 Duration of Courses

   a) There will be two semesters in an academic year. Each semester will be of eighteen weeks duration, including classes and conduct of examinations.

   b) The Fall semester, will start in the first week of September and the Spring semester will begin in the first week of February.

1.13 Degree Requirements

   a) Total of 33 credit hours (including 6 credit hours of research) are required to complete the Master's Degree Programme. The 27 credit hours of course work shall include a minimum of 6 courses from the core area of specialization and 3 credit hours of the course "Research
Methodology". This course will be registered as credit course.

b) A student can take up to two courses being offered by Teaching Departments other than his own if so advised by the Academic Advisor/Chairman. The student shall be entitled for the credit of such courses.

c) On the completion of course and research work, the student shall apply for defence of thesis on a prescribed proforma available from the Directorate of Postgraduate Studies/Departmental Postgraduate Advisor and University website (www.nwfpuet.edu.pk). The final script of the thesis must be certified against plagiarism by the Quality Enhancement Cell (QEC) of the University before the thesis defence.

d) After successful defence of research work, the student shall submit three hard-bound copies of the final script of thesis to the Director Postgraduate Studies within fifteen days of defence as per format approved by the statutory bodies of the University. The format of the thesis will be checked by Supervisor. The copies shall be kept in the Departmental Seminar Library, Central Libearry of the University and the Directorate of Postgraduate studies.

e) The student must complete all the requirements of the M.Sc Degree within seventy-two months (12 semesters) of the first registration for the programme. Moreover, the candidate must complete all the course requirements within forty-eight months (8 semesters) of the first registration for the programme. Students enrolled in M.Sc. programmes of NIUIP must complete all requirements of M.Sc. degree within forty eight months (08 semesters) of first registration for the programme. Moreover, the students must complete all course work requirements within thirty six (36) months of first registration for the programme.

f) The degree of Master of Science (M.Sc) shall be awarded to a student who has satisfactorily completed the courses of study and research and has passed the required examinations.

g) The student shall apply for the award of M.Sc degree on a prescribed proforma available from Directorate of Postgraduate studies/Departmental Postgraduate Advisor and University website (www.nwfpuet.edu.pk). The proforma shall be used to verify all the requirements of the degree, i.e. passing of core courses, total courses and thesis defence examination.
h) The admission of the student will be cancelled if he/she remains absent continuously for two semesters without freezing the semester. The student will be issued attended semesters transcript.

1.14 Residency Requirements
a) The student shall earn all the credits of course work and complete the research at the University.

b) In special circumstances, the BOASAR may permit the research to be carried out in another organization/ institution. In such an event the student will be assigned a co-supervisor with at least MS qualification working in that institution, who will be paid honorarium equal to half of honorarium paid to the main supervisor. However, the student shall maintain a supervisor from parent department or relevant department of the University with consent of the chairman of parent department in consultation with PREC members.

1.15 Transfer of Credits
In case of change of MS stream/admission in another stream of engineering, a maximum of six credits of the previous stream may also be allowed if approved by the concerned PREC.

1.16 Scholastic Record
The scholastic record of graduate students shall be maintained by the Controller of Examinations. Departments offering Postgraduate courses shall send award list of grades to the Controller of Examinations, within one week of final examination. The students shall be notified about their final grades by the Postgraduate Advisor of the department.

1.17 Discipline
Students enrolled in the Postgraduate Programme shall observe the rules and regulations of the University. Any infringement shall be dealt with under the University Discipline Rules.

1.18 Assistantships and Free ships
Subject to the availability of funds in the budget, limited number of teaching and tuition free ships are granted to Postgraduate students who are willing to perform academic duties during working hours of the University.

a) Teaching Assistantship: teaching undergraduates. Rs. 5000/- per month with tuition free ship.

b) Research Assistantship: assignment on project work. Rs.5000/- per month with tuition free ship

c) Other fellowship/financial assistance shall be announced when available.
1.19 Admission on Rationalized Fees Basis

a) Eligibility criteria for "Rationalized Fees Based" applicants are the same as for open merit applicants.

b) Fees for Rationalized Fees Based Students are shown in Table 4. In case of Admission Cancellation the refund policy is as under:

<table>
<thead>
<tr>
<th>% of Tuition Fee</th>
<th>Time Line for Semester System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full (100%) Fee refund</td>
<td>Upto 7th day of commencement of classes</td>
</tr>
<tr>
<td>Half (50%) Fee refund</td>
<td>From 8th-15th day of commencement of classes</td>
</tr>
<tr>
<td>No Fee (0%) refund</td>
<td>From 16th day of commencement of classes</td>
</tr>
</tbody>
</table>

Late fee of Rs.200/- per day (maximum upto Rs.1,800/-) will be charged from the students who failed to deposit the University dues/funds within due date for any reason.

c) A private student who wishes to take a course without taking admission in the Master's Programme, should formally submit an application to the Chairman of the Department concerned. After permission of the Chairman concerned, he/she will be allowed to enroll subject to the availability of space after payment of Rs. 20,000/- per course. Further he/she will not be allowed to take more than two courses without taking admission in Master's Programme. He/she will be awarded a Certificate by the Chairman of the Department concerned for attending the course(s) without claiming any credit.
Ph.D Degree Programme

CGPA of 3.0 in a relevant discipline so recognized by the University. For details on area of specialization, the chairman of respective Peshawar department should be contacted. The Ph.D. Programme shall extend over a period of at least three years from the date of first registration for a full-time, and at least four years for a part-time student. The Ph.D. Programme is task-oriented rather than time-oriented. The Ph.D. work will be considered complete only when the supervisor and the Research Evaluation Committee (REC) are satisfied. The student must register for at least 54 credit hours. While undertaking research work, the candidate shall be encouraged to attend seminars, conferences, symposia and publish papers in journals of national or international repute. Upon recommendation of the Supervisor, BOASAR will provide funding to the candidate. The Director Postgraduate Studies will present his recommendations (including the name of the proposed Supervisor). The application should include a brief proposal of research to be carried out by the applicant, along with CV and a list of any previous research publications. The University authorities reserve the rights to make any change in the rules, regulations, fees structure and courses of study that may be considered necessary at any time without prior notice.

Special Provisions

1. In all cases where regulations are silent, the decisions of the vice-chancellor shall be final.
2. All other regulations and instructions relating to Master’s Engineering courses issued here-to-fore stand repealed.
3. Interpretation of these rules and regulations by the authorized officers of the University shall be final.

Table 4: Fees and other Charges for Rationalized Fees Students

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Item</th>
<th>Pakistani Nationals (Rs.)</th>
<th>Foreign Students (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Registration Fees (per semester)</td>
<td>2500.00</td>
<td>90.00</td>
</tr>
<tr>
<td>2</td>
<td>Tuition Fee (per credit hours)</td>
<td>6500.00</td>
<td>180.00</td>
</tr>
<tr>
<td>3</td>
<td>Computer Fund (per semester)</td>
<td>1500.00</td>
<td>90.00</td>
</tr>
<tr>
<td>4</td>
<td>Library Fund Non Refundable (per semester)</td>
<td>2000.00</td>
<td>90.00</td>
</tr>
<tr>
<td>5</td>
<td>Library &amp; Lab. Security (on first registration) Refundable</td>
<td>5000.00</td>
<td>400.00</td>
</tr>
<tr>
<td>6</td>
<td>Field Trips (Charged when a field Trip organize)</td>
<td>1500.00</td>
<td>90.00</td>
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<td>7</td>
<td>Thesis Evaluation Charges (on submission of Thesis)</td>
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</tr>
<tr>
<td>14</td>
<td>Utility charges (per semester)</td>
<td>2500.00</td>
<td>21.00</td>
</tr>
</tbody>
</table>
Ph.D Degree Programme

GENERAL

These rules apply on all Ph.D. Programmes in which UET Peshawar will be sole degree awarding authority. The Ph.D. programme shall extend over a period of at least three years from the date of first registration for a full-time, and at least four years for a part-time student. The Ph.D. Programme is task-oriented rather than time-oriented. The Ph.D. work will be considered complete only when the supervisor and the Research Evaluation Committee (REC) are satisfied.

The student must register for at least 54 credit hours. While undertaking research work, the candidate shall be encouraged to attend seminars, conferences, symposia and publish papers in journals of national or international repute. Upon recommendation of the Supervisor, BOASAR will provide funding to the candidate for presenting a paper at a relevant Seminar/Conference/ Symposium at least once every year during his/her research.

All research work will be carried out at UET, Peshawar, unless otherwise advised by the Supervisor. Part-time students must also fulfill the residency requirement by registering as full-time students for at least two years. In case of joint research proposal with industry or another university, residency requirement will be established by supervisor and co-supervisor (member from Industry/another university).

RULES

2.1 Admission

a) Ph.D. programme shall be open to applicants who have Master's/M.Phil degrees with a minimum CGPA of 3.0 in a relevant discipline so recognized by the University. For details on area of specialization, the chairman of respective department should be contacted.

b) The DPGS in consultation with the heads of departments will invite applications for admission to the Ph.D. programme at the same time as Master's admissions. The application should include a brief proposal of research to be carried out by the applicant, along with CV and a list of any previous research publications. The candidates must fulfill the criteria for admission as mentioned in clause 2.1 (i).

c) The Chairman, in consultation with the Departmental Project Research Evaluation Committee (PREC) will scrutinize the applications and forward it to the Director Postgraduate Studies with his recommendations (including the name of the proposed Supervisor).

d) The Director Postgraduate Studies will present the credentials to the University Admission Committee for recommendation and to the Vice-Chancellor for final approval.

e) Applicants selected for admission will be so informed by the Head of the Department concerned and their names shall also be notified on the Notice Board of the Department and of the Directorate of Postgraduate Studies.

f) The applicant will have to register within one
Ph.D Degree Programme

month of the notification or the beginning of the forthcoming semester, whichever is later, by paying the prescribed fees for the first semester.

g) A Ph.D. candidate must complete at least 18 credit hours Ph.D. level course work with a minimum CGPA of 3.0, followed by a comprehensive examination along with thesis defense, which will be essential for the award of Ph.D. degree.

h) The student must register for a minimum total of 54 credit hours.

i) A Ph.D. student may be allowed to register in an advanced Postgraduate course as a single participant with the approval of the Dean.

j) No supervisor shall have more than five (05) candidates for Ph.D. simultaneously, unless authorized by a committee comprising the Dean, the Head of Department and the Secretary BOASAR.

k) The candidates seeking admission in Master's leading to Ph.D. programme must have:

   (i) Sixteen years of schooling or four (04) years education after F.Sc (130 credit hours) will be compulsory for admission in Master's programme leading to Ph.D.

   (ii) Before moving into the Ph.D. programme, candidates will need to complete 33 credit hours out of which 27 credit hours will be reserved for course work and the remaining 6 credit hours will be reserved for Master's research work, which may lead to the award of Master's Degree in Engineering.

l) The candidates seeking admission in Ph.D. Programme must have:

   (i) A Masters/M.Phil/ equivalent degree in the related field with minimum CGPA 3.0 out of 4.0 or 3.75 out of 5.0 or First Division in annual system. The percentage will be valid only if the CGPA is not mentioned in the degree/transcript.

   (ii) 18 years of education with Masters / MS/M.Sc or equivalent degree from abroad or 17 years of education with MS/M.Sc from abroad.

   (iii) GRE Subject Test (International) Score (score >= 60%), Subject Test Score (score >= 60%) conducted by University Appointed Testing Authority (UATA) or the Subject Test (score >= 70%) conducted by the Department concerned will be considered.

m) Interpretation of these rules and regulations by the authorized officers of the University shall be final.

2.2 Ph.D. Candidature

a) The student will become a candidate for Ph.D degree after passing the Qualifying Examination and on the recommendation of the Supervisor concerned.

b) Within two months of passing the Qualifying Examination, the Supervisor, with the approval of the Head of the Department, shall constitute a REC for each candidate comprising qualified persons and shall send it to the office of BOASAR for approval of the Board. All committee
members must have Ph.D. degree except possibly No. V.

(i) The Supervisor (expert in the subject) from the department concerned.
(ii) One member from the department concerned.
(iii) One member from a department other than the concerned department.
(iv) One member from a university other than UET, Peshawar.
(v) One member from a Research Institute/Industry. Any member from the above may be appointed as a Co-Supervisor for the candidate, if required. The names shall be submitted for approval of the vice-chancellor through Director Postgraduate Studies. The Supervisor shall act as the Chairman of the REC. The REC shall meet once a year and monitor the research work of the candidate. If Supervisor is unable to continue, the Head of Department in consultation with REC shall appoint a new Supervisor (preferably a REC member) of the student's research. The new Supervisor may associate a Co-Supervisor from the faculty available within the University or outside the University. The REC, shall also act as an Examination Committee. The quorum for the REC shall be at least three members and for Examination Committee at least four members including at least one member from outside the University. The Supervisor shall act as the head of the committee.

The REC may advise the student to go ahead if it is satisfied with the annual progress of the work or to discontinue if it is not satisfied.

2.3 Examination

2.3.1 Ph.D. Qualifying Examination

a) Each department shall conduct Ph.D. qualifying examination on a regular basis. It will be a written exam on pass/fail basis designed to test knowledge of basic principles in core areas relevant to the candidate's research field.

b) A Ph.D. student must appear in the qualifying examination within six months of the date of his course completion. Students who fail will be allowed to repeat the examination once only within six months of the declaration of qualifying examination result.

c) Students who fail the Qualifying examination twice will not be allowed to continue their Ph.D.

d) The Qualifying Examination Committee should comprise of 3 members including concerned Ph.D. Supervisor. The members of Qualifying Examination Committee will be nominated by the concerned supervisor and appointed by the Chairman of the respective department by taking into consideration the core areas of the research. All the members will assess and evaluate the potential of the student independently with regard to the initiative of Ph.D. research in the relevant field. The Qualifying Examination Committee shall declare the result of the student on pass/fail.
2.3.2 Foreign Thesis Evaluation

a) Two Foreign Thesis Evaluators from technologically advanced countries will be nominated by the supervisor concerned for a Ph.D. student within six months of passing the qualifying examination. The supervisor will submit nomination to the Director Postgraduate Studies who will recommend these names to Dean for final approval of vice-chancellor.

b) The Foreign Thesis Evaluators will be required to review the research proposal and progress report of the Ph.D. student on regular basis, and their comments will be incorporated in the research accordingly.

c) Thesis evaluation by the foreign evaluators will be on the following basis:

(i) That thesis is satisfactory, Viva-voce examination may be held to enable the candidate to defend his thesis, (No correction), OR

(ii) That the thesis may be resubmitted by the candidate after revision on the proposals suggested by the members, OR

(iii) That the thesis be rejected as it is not of merit and candidate be declared ineligible.

2.3.3 Ph.D. Preliminary (or Proposal Defense) Examination

a) Within one year of passing the qualifying Examination, candidate should appear in a preliminary examination conducted by the REC. The candidate will submit his/her research proposal on the approved format along with literature survey in written form to the REC at least two weeks prior to the examination. In this examination, the candidate will make an oral presentation and defend his/her proposal in front of the REC. The candidate will incorporate necessary changes if suggested by the REC in the proposal and submit to the office of BOASAR through his/her supervisor for approval of the Board.

b) The purpose of preliminary examination is to confirm that the candidate understands the problem, is aware of the associated literature, has a realistic research plan and schedule, and the research problem is of Ph.D. standard. If the REC is satisfied, the candidate will be allowed to proceed. If not, he/she may be given one more chance to pass the preliminary examination.

2.3.4 Evaluation of Thesis

The REC shall first evaluate the thesis to ascertain that:

Thesis makes a distinct contribution in the area of specialization of the candidate, and it shows the ability of the candidate for original investigation and for understanding the relationship of his/her research with a wider field of knowledge.
Thesis evaluation by the REC will be on following basis:-

a) Each member shall submit his report independently to the Director Postgraduate Studies on prescribed Proforma recommending:-

(i) That thesis is satisfactory, Viva-voce examination may be held to enable the candidate to defend his thesis, (No correction),

OR

(ii) That the thesis may be resubmitted by the candidate after revision on the proposals suggested by the members,

OR

(iii) That the thesis be rejected as it is not of merit and candidate be declared ineligible.

b) The recommendations made by a majority of the members of the REC shall be implemented. In case of a tie of difference of opinions, the BOASAR shall recommend to the vice-chancellor for appointing a neutral examiner whose opinion shall be final.

c) Re-submission of thesis shall be allowed only once. In case the resubmitted thesis is not of merit, the candidate shall be declared ineligible for the Ph.D. degree.

2.3.5 Ph.D. Thesis Defence Examination

a) A candidate ready for Ph.D. thesis defence examination shall apply to the Director Postgraduate Studies on the prescribed proforma along with six copies of his/her hard-bound thesis and a certificate from his/her Supervisor duly countersigned by the Head of Department about the satisfactory completion of his/her research and thesis in accordance with the prescribed format of thesis. In addition, the final script of the thesis must be certified against plagiarism by the Quality Enhancement Cell (QEC) of the university before the thesis defence.

b) The thesis may be submitted within a maximum period of five years from the date of candidature in case of regular candidates and six years in case of part-time students provided that in exceptional cases, on the recommendations of the Supervisor/the Director Postgraduate Studies, the vice-chancellor may extend the period by a maximum of two years.

c) After the expiry of duration mentioned above, the candidate may be allowed to register as a fresh candidate, if he/she so desires.

2.3.6 Viva-Voce

a) After the thesis has been evaluated as satisfactory, Viva-Voce Examination shall be held at a place and date as may be determined by the Dean on the recommendations of the Director Postgraduate Studies.
Ph.D Degree Programme

b) Such places and dates shall be made public by the Director Post Graduate Studies through at least two national dailies of repute and also by invitation to such other institutions of learning and research as may be related to the area of specialization of the candidate.

c) The Viva-Voce Exam shall be conducted by the Examination Committee,

2.4 Funding

a) All students must be available for a minimum period of two years as full time regular student taking leave from their jobs, if necessary. In case of financial need, a student may be awarded a teaching assistantship of up to Rs.8000/- per month on the recommendation of the supervisor concerned.

b) The matter of study leave and scholarship (for paying fees) of faculty members getting admission in Ph.D. will be decided as per existing rules of the University for leave and scholarship.

c) Students funded by the University should give an undertaking to pay back the University all expenses incurred on their Ph.D. in case of willful abandoning of the Ph.D. programme as ascertained/ notified by the Supervisor.

d) Funding for each Ph.D. student will be released annually by BOASAR on the recommendation of the REC. However, funds for the first year will be released upon first registration of the student, since REC is not yet constituted.

2.5 UNIVERSITY FEES

University fees will be charged at rates prescribed in Table-2 (Page-253) for Open Master's students.
2.6 Ph.D. SPLIT PROGRAMME

The Ph.D. Split Programme will include those Ph.D. Programmes which involve joint supervision from the two universities participating in the programme. The student will be registered with both the institutions. The student will abide by the rules and regulations of the degree awarding institution and additionally will follow all those terms and conditions having mutually agreed upon by the two institutions in the Split Ph.D. Programme.
Conduct & Discipline Regulations

1. TITLE
These regulations are framed under clause-7 (ii), of the First Statute of the schedule of the University of Engineering and Technology Amendment ordinance, 1981 and may be called “The University/Colleges Students Conduct and Discipline Regulations”.

The University Discipline Committee constituted under clause-7 (ii) of the First Statutes of the Schedule of the University of Engineering and Technology, Amendment Ordinance, 1981 shall have the authority and jurisdiction to deal with, and decide, all cases of indiscipline, in accordance with the University Students Conduct and Discipline Regulations.

2. APPLICABILITY AND COMMENCEMENT
These regulations shall apply to all students on the rolls of the University and the affiliated Colleges of the University.

3. STUDENTS CODE OF HONOUR
Every student shall observe the following code of conduct:-
(a) Faithfulness in his religious duties, and respect for convictions of others in matters of religion, conscience and customs.
(b) Loyalty of Pakistan, and refraining from doing anything which might lower its honour and prestige in any way.
(c) Truthfulness and honesty in dealing with others.
(d) Respect for elders, and politeness to all, especially to women, children, old people, weak, deformed and the helpless.
(e) Respect for teachers and others in authority in the University.
(f) Cleanliness of body, mind, speech and habits.
(g) Helpfulness to fellow-beings.
(h) Devotion to studies and sports.
(i) Protection of Government property.

4. PROHIBITED ACTS
The students should refrain from:-
(a) Smoking in class-rooms, laboratories, workshops, examination halls, or Convocation Hall, and during study or academic functions.
(b) Using or carrying of alcoholic drinks or other intoxicating drugs, within the University Campus or University Hostels or during instruction, sports or cultural tours or survey camps or entering such places or attending any such tour of camp while under the influence of such intoxicants, or any other University/College functions outside the Campus.
(c) Organizing or taking part in any function within the University campus or hostel, or organizing any club or society of students or students associations, unions and federations, except in accordance with the prescribed rules and regulations.
(d) Collecting any money, receiving funds or pecuniary assistance for, or on behalf, of the University, except with the written
permission of the vice-chancellor /Principal.

(e) Staging, inciting or participating in any walk-out, strike, or other form of agitation against the University or its teachers or officers, inciting any one to violence, disruption of the peaceful atmospheres of the University in any way, making provocative speeches or gestures which may cause resentment, issuing of pamphlets or cartoons casting aspersions on the teachers or staff of the University or the University bodies, or doing anything in anyway likely to promote rift and hatred among the various groups or castes of students community, issuing statements in the press making false accusations or lowering the prestige of the University or writing and pasting posters on the walls.

(f) Bringing, carrying and keeping of fire arms or any other weapon (of any nature/type) forbidden by law, within the University Campus, class-rooms, hostels and offices.

(g) Causing damage to University property or government public property.

(h) Use of loud speakers, mega-phones, “decks” in the University hostels and on campus.

5. ACTS OF INDISCIPLINE

A student will be deemed to have committed an act of indiscipline if he/she:

(a) Commits a breach of rules of conduct specified above, or

(b) Disobeys the lawful order or a teacher or other person in authority in the University, or

(c) Habitually neglects his work or habitually absents himself from his class without valid reason; or

(d) Wilfully damages University (or) public property or the property of a fellow student or any teacher or any employee of the University or

(e) Does not pay the fees, fines, or, other dues payable, under the University Regulations and Rules; or

(f) Does not comply with the rules relating to residence in hostels, or uses indecent language, wears immodest clothes, makes indecent remarks or gestures, or behaves in a disorderly manner, or commits any criminal immoral or dishonorable act (whether committed within the University Campus or outside) or any act which is detrimental to the interest of the University. False personification or giving false information or willful suppression of facts, information cheating or deceiving the University

(g) Forging, mutilating, altering erasing or otherwise tampering with any document connected with examination, receipt of University fees / dues or making undue use of such documents.
6. PROCEDURE IN CASE OF BREACH OF DISCIPLINE

The vice-chancellor, if in his opinion an act of indiscipline can more appropriately be dealt with by the University Discipline Committee, may refer it to the University Discipline Committee for necessary action under the Rules/Regulations.

7. RUSTICATION AND EXPULSION

(i) Rustication
   (a) Rustication, whenever imposed on a College/University student, shall always mean the loss of one semester or one academic year so far his appearance in a University examination is concerned. The rusticated student may be admitted in the University on the expiry of the rustication period.
   (b) No fee will be charged from a rusticated student for the month or months during which his name is struck off the rolls.

(ii) Expulsion
   (a) The period of expulsion will be counted from the date of issue of such a notice by the University. Expulsion period can vary.
   (b) Name of the expelled student will immediately be removed from the Department's rolls, and no fee will be charged from him/her for subsequent months.

(c) A student expelled from a Department may be re-admitted into that Department or another affiliated College after the expiry of the period of expulsion.

(d) Cases of expulsion will be registered in the University and notified to all Departments and Universities.

8. GENERAL

(i) The authority, which has the power to rusticate could also withdraw the same order before the expiry of the period.

(ii) No student shall be rusticated/expelled from the University unless he has been served with the Show Cause Notice, and allowed a reasonable time for explanation and replying to the charges framed against him.

(iii) When in the opinion of the Discipline Committee the rustication or expulsion is not called for in a case referred to it, may impose any other penalty or penalties mentioned in the above Regulations.

9. APPEAL

(i) An appeal against the punishment awarded by the University Discipline Committee can be made to the Appellate Committee.

(ii) No appeal by a student against the decision
of the University Discipline Committee shall be entertained unless it is presented within thirty days from the date on which the decision is communicated to him. This code of conduct will repeal all previous Regulations relating to Expulsion and Rustication or any other instructions relating to the maintenance of discipline among the students.
UNIVERSITY CONDUCT & DISCIPLINE REGULATIONS 2002 (Amended in 2006)

Penalties which may be imposed by the University authorities for various offences committed are given below:

<table>
<thead>
<tr>
<th>S.No</th>
<th>OFFENCE</th>
<th>PENALTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Using/carrying of alcoholic drinks or other intoxicating drugs within the University Campus or University Hostels or during Study Tour or Cultural Tours or Survey Camps, any such tours of any other University/College or outside the campus under the influence of such intoxicants or misbehaving with others, especially females, during tours etc.</td>
<td>Debar from classes for one week or fine not exceeding Rs. 10,000/- OR Expulsion from the University.</td>
</tr>
<tr>
<td>2.</td>
<td>Organizing or taking part in any function within the University Campus or hostel or organizing any club or society of students or students association, unions or federation, except in accordance with the prescribed rules and regulations.</td>
<td>Stern warning and/or Fine not exceeding Rs. 20,000/-, AND/OR Expulsion from hostel accommodation, if relevant.</td>
</tr>
<tr>
<td>3.</td>
<td>Collecting any money or receiving funds or pecuniary assistance for or on behalf of the University, except with the written permission of the vice-chancellor.</td>
<td>All money supposed to have collected shall be confiscated in favour of the University. AND/OR Fine not exceeding Rs. 10,000/-</td>
</tr>
<tr>
<td>4.</td>
<td>Staging or inciting or forcing fellow students to a walkout from classes or examination halls or organizing, conducting or participating in strikes or agitation or violence against the University authorities or members of teaching or administrative staff or disrupting the classes or any other academic activity of the University being held inside or outside the campus.</td>
<td>Expulsion from the University for one to four semesters/two academic years, depending on the nature and gravity of the crime. AND/OR Fine not exceeding Rs. 20,000/-</td>
</tr>
<tr>
<td><strong>S.No</strong></td>
<td><strong>OFFENCE</strong></td>
<td><strong>PENALTY</strong></td>
</tr>
<tr>
<td>---------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>5.</td>
<td>Casting aspersions or using abusive and derogatory language in speeches, pamphlets or posters against the University authorities or members of teaching or administrative staff of the University or physically manhandling, beating or disgracing the University authorities or members of the teaching or administrative staff of the University or committing an act of moral turpitude against fellow students.</td>
<td>Expulsion from the University for one to six semesters/ three years, depending on the nature and gravity of the crime. AND / OR Fine not exceeding Rs. 30,000/-</td>
</tr>
<tr>
<td>6.</td>
<td>Conducting or inciting or participating in a violent attack on the offices of the University authorities, Chairmen, faculty members or other officers of the University.</td>
<td>Permanent expulsion from the University. AND / OR Fine not exceeding Rs. 50,000/-</td>
</tr>
<tr>
<td>7.</td>
<td>Damaging/destroying or trying to damage/ destroy the property (movable or immovable) of the University or University employees or Government or any other Public Organization or stealing or taking away by force any item of University property.</td>
<td>Recovery of the amount equal to the value of the damage caused; and / or fine not exceeding Rs. 20,000/- AND / OR Rustication from the University.</td>
</tr>
<tr>
<td>8.</td>
<td>Bringing, carrying or keeping or firing of arms or any other weapon (of any nature/type) within the University campus or class rooms or hostels or examination halls or offices of the University.</td>
<td>Fine not exceeding Rs. 20,000/- AND / OR Expulsion from the hostel. Expulsion from the University for a maximum period of two semesters / one year.</td>
</tr>
<tr>
<td></td>
<td>Conduct &amp; Discipline Regulations</td>
<td></td>
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<td>---</td>
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<td>--------------------------------------------------------------------------------------------</td>
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<tr>
<td>9.</td>
<td>Using loudspeakers or mega-phones in the University hostels or on the University campus or making provocative speeches or gestures which may cause resentment or doing anything in anyway which is likely to promote rift and hatred among various groups or castes of students community or issuing statements in the press, making false accusations against the University or University Authorities or members of teaching staff.</td>
<td>Fine not exceeding Rs. 20,000/-; expulsion from the hostel. AND/OR Expulsion from the University for maximum period of two semesters / one year.</td>
</tr>
<tr>
<td>10.</td>
<td>Misbehaving and not cooperating with faculty members, University proctors, Hostel Wardens, and other authorities.</td>
<td>Fine not exceeding Rs. 20,000/-; expulsion from the hostel. AND/OR Expulsion from the University for maximum period of two semesters / one year.</td>
</tr>
<tr>
<td>11.</td>
<td>Forming political wing of any political party, student union, student federation, or associations based on linguistic, ethnical, territorial, religions affiliation, or any other platform.</td>
<td>Fine not less than Rs. 5,000/- AND/OR Stern warning. Rustication / expulsion from University.</td>
</tr>
<tr>
<td>12.</td>
<td>Holding “Dars” or “Waaz-o-Naseehat” and collection of funds for political, religious party or group within the campus without permission of the University authorities.</td>
<td>Rustication / expulsion from University. AND/OR Fine not exceeding Rs. 30,000/-</td>
</tr>
<tr>
<td>13.</td>
<td>Carrying any activity of what-so-ever nature that does not come under the definition of curricular and co-curricular activities that is not allowed and organized by the University authorities.</td>
<td>Rustication / expulsion from University. AND/OR Fine not exceeding Rs. 20,000/-</td>
</tr>
</tbody>
</table>
Using loudspeakers or mega-phones in the University hostels or on the University campus or making provocative speeches or gestures which may cause resentment or doing anything in anyway which is likely to promote rift and hatred among various groups or castes of students community or issuing statements in the press, making false accusations against the University or University Authorities or members of teaching staff.

Fine not exceeding Rs. 20,000/-; expulsion from the hostel.

AND / OR

Expulsion from the University for maximum period of two semesters / one year.

9. Misbehaving and not cooperating with faculty members, University proctors, Hostel Wardens, and other authorities.

Fine not exceeding Rs. 20,000/-; expulsion from the hostel. AND / OR

Expulsion from the University for maximum period of two semesters / one year.

10. Forming political wing of any political party, student union, student federation, or associations based on linguistic, ethnical, territorial, religions affiliation, or any other platform.

Fine not less than Rs. 5,000/-     AND / OR

Stern warning.

Rustication / expulsion from University.

11. Holding “Dars” or “Waaz-o-Naseehat” and collection of funds for political, religious party or group within the campus without permission of the University authorities.

Rustication / expulsion from University.

AND / OR

Fine not exceeding Rs. 30,000/-

12. Carrying any activity of what-so-ever nature that does not come under the definition of curricular and co-curricular activities that is not allowed and organized by the University authorities.

Rustication / expulsion from University.

AND / OR

Fine not exceeding Rs. 20,000/-

13. Conduct & Discipline Regulations
GENERAL

Accommodation in hostels is a privilege and cannot be claimed as a matter of right. Accommodation being limited in hostels may not be provided to all the applicants and will be provided only on the availability of seats in Researchers Hostel. The residential accommodation is an equal and merit based opportunity and preference is given only to those applicants who hail from far-off places.

Researchers Hostel Peshawar:
45 Rooms, 90 Seats (2-Seater)

The hostel is looked after by a resident warden, who is responsible for the implementation of hostels rules, maintenance of order and discipline in the hostel. The Resident Warden is the first point of contact between the Resident students and university administration.

All complaints regarding any student or member of hostel staff, any queries and any problems relating to hostel shall be brought forth before the Resident Warden. Students must never take matters into their own hands. Bearers and other staff have been provided in the hostel to facilitate resident students. The Provost serves as the overall in-charge of the hostels and sets policy guidelines for the hostel administration.

Security officer will supervise a team of highly trained security guards recruited from retired Pakistan Army personnel. Security guards will perform duty on the gates of the hostels who will only allow lawful residence into hostels. Security officer will be overall incharge of security of hostel. He can pay surprise visits to rooms of the hostel at any time for check of any weapon, drugs, intoxicant, rods, daggers and harmful materials etc. The residents of hostel are required to abide by the rules and regulations of the university hostel as laid down in this prospectus and notified from time to time by the hostel and university administration. Misconduct by any resident student may be punished directly by the Resident warden with a fine of up to Rs. 10000/- or it may be reported by the Resident Warden to the Convener Hostel Disciplinary Committee through the Warden for further action. The Hostel Discipline Committee may forward any case to University Discipline Committee (UDC), if it deems fit.
1 ADMISSION

1.1 Hostel admission will be granted only to those students who are on regular rolls of the University. The facility of hostel accommodation to full time postgraduate students may be provided subject to availability.

1.2 Students desirous of hostel accommodation are required to apply on the prescribed hostel admission form on or before the last date announced for the purpose. Students shall submit duly completed forms, along with five Passport size photographs duly attested by the head of the concerned department, to the office of the Head of their respective department. The forms after necessary scrutiny will then be forwarded to office of the Provost.

1.3 Seats in the hostel will be allocated to each department in proportion to the number of applicants for hostel accommodation from each department. Preference shall be given to those applicants who hail from far-flung areas and do well in terms of merit.

1.4 The hostel authority has the right to refuse/cancel hostel admission of students who misuse their privilege.

1.5 A student can request the cancellation of his/her hostel admission. The student will be eligible to receive all the refundable amounts if the request is received within one month of the closing date of allotment of hostel accommodation. No refund will be allowed after that.

1.6 A student whose admission is cancelled by the hostel authorities on disciplinary grounds shall not be entitled to receive his hostel security.

2 ALLOTMENT

The warden of a hostel shall provide room/seat to a student within three days of the submission of his/her hostel card. However, handing over/possession may take longer depending upon the time required to complete the process of shifting by ex-room holders.

3 HOSTEL DISCIPLINE & ORDER

3.1 The Residents students must submit an undertaking of good conduct as provided by the university on judicial stamp paper before they can be issued hostel admission cards. The affidavits must be duly signed by the parent/guardian of the concerned student. A student, who fails to submit the duly filled affidavit, shall not be allowed to enter the hostel. The following must also be ensured with regards to the guardian of a student:

(a) A guardian can only be a Blood Relative i.e. elder sibling, paternal or maternal uncle.

(b) The parent/guardian must accompany the student to the hostel and he/she would be required to submit a copy of his/her CNIC along with the affidavit.

(c) Any student, who fails to furnish the above,
shall not be allowed to enter the hostel premises.

(d) Every resident student shall be issued a boarder card, after due verification and collection of duly filled affidavits. The students must keep these cards at all times with them and they will be allowed entry into their hostels only after presenting this card to the security guard.

(e) Residents shall abide by hostel rules and regulations in letter and spirit. Violation of hostel rules and regulations or any order issued by the hostel administration shall render a resident liable for imposition of fine and/or expulsion from the hostel and to such other actions as deemed fit by the University authorities.

3.2 Anybody (be it a student of the university) who is not a resident of the hostel is not allowed to enter or stay in the hostel premises.

3.3 Resident students can entertain their guests within the prescribed visiting hours only in the guest rooms prescribed for the said purpose in each hostel. No resident can entertain a guest in his room.

3.4 Residents are strictly forbidden of keeping any arms, intoxicants, drugs, rods or daggers, and harmful materials etc in the hostel. Any violation of this rule will result in serious disciplinary against the violator and may lead to imposition of heavy fines and expulsion from the hostel. The hostel administration may initiate criminal proceedings against the violator and refer the matter to the police.

3.5 Every Resident student is responsible for the peace and tranquility of hostel environment. Resident students are not allowed to play music or any instrument loudly.

3.6 Residents are not allowed to participate in any political activity.

3.7 Residents are not allowed to invite any political figure, scholar or any individual for any speech, lecture or sermon or to circulate any unpublished or published material for this purpose.

3.8 Residents are not allowed to assemble crowds or congregations within the hostel premises for any purpose e.g lunch, dinner, iftaar, political etc.

3.9 Entry of females into boys' hostels is strictly prohibited & vice versa.

3.10 Residents shall keep their rooms clean and tidy. They shall also be responsible to keep their rooms properly locked in case they leave the room. Residents shall not keep expensive items (cost of which exceeds Rs. 1000/-) or cash in their rooms. The hostel authorities will not be responsible for any loss.
3.11 Residents are not allowed to park bicycles, motorcycles or cars within the hostel premises. The hostel authorities would not be responsible for any loss or damage incurred by the student.

3.12 Residents are not allowed to ride bicycles or motorbikes inside the hostel premises. Any violation will be dealt with seriously.

3.13 Resident students shall not use and shall not allow the use of their accommodation for any purpose other than that prescribed and allowed by the hostel administration.

3.14 Resident students who in the view of the hostel authorities are not residing in their rooms shall have their hostel admissions cancelled.

3.15 Any complaints against the hostel staff may be brought into the notice of the hostel warden or the provost. Residents are not allowed to deal with the hostel staff directly on their own.

3.16 Resident students shall not insist on the hostel bearers to bring contraband goods for them. Residents shall not insist on the hostel staff to indulge in activities other than their prescribed job responsibilities.

3.17 The Warden of the hostel may impose a fine of up to Rs. 5000/- on any resident student who violates the hostel rules and regulations or orders of the hostel authorities. Prior to imposing any penalty on the Resident Student the Warden may serve him with a show cause notice to which student must respond in writing within the specified timeframe. The Warden may decide to do away with any penalty if he finds the response of the student satisfactory or may decide otherwise. The Warden may forward the case to the Hostel Discipline Committee through the Senior Warden for further action. The Hostel Discipline Committee can report a case of indiscipline to the University Discipline Committee if it deems fit.

3.18 Appeal

An appeal against the punishment awarded by the Resident Warden shall be forwarded to the Hostel Discipline Committee within fifteen days.

4 HOSTEL DISCIPLINE COMMITTEE

4.1 The Hostel Discipline Committee (HDC) will be formed by the Provost under clause 8 of Khyber Pakhtunkhwa, UET Ordinance No. XIII of 1980 and (amended) Ordinance No. IX of 1981.

4.2 Cases of indiscipline by the resident students may be forwarded to the Hostel Discipline Committee by the Resident Warden. The Convener of HDC in consultation with the Provost will call a meeting of HDC, at a place and time convenient to the committee members, to conduct hearings in the case.

4.3 The Hostel Discipline Committee will decide the cases according to hostel conduct and discipline regulations.
Hostel Regulations

4.4 The Hostel Discipline Committee may forward the cases needing severe penalties (such as

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Description of Charges</th>
<th>Amount (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>University Funds</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Hostel Admission Fee</td>
<td>500.00</td>
</tr>
<tr>
<td>2.</td>
<td>Hostel Rent per seat</td>
<td>12000.00</td>
</tr>
<tr>
<td>3.</td>
<td>Service Charges</td>
<td>2000.00</td>
</tr>
<tr>
<td>4.</td>
<td>Electricity Charges</td>
<td>3000.00</td>
</tr>
<tr>
<td>5.</td>
<td>Crockery Funds</td>
<td>500.00</td>
</tr>
<tr>
<td>6.</td>
<td>Furniture Funds</td>
<td>500.00</td>
</tr>
<tr>
<td>7.</td>
<td>Livery Charges</td>
<td>200.00</td>
</tr>
<tr>
<td>b)</td>
<td>Hostel Funds</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Hostel Security (Refundable / Adjustable)</td>
<td>6000.00</td>
</tr>
<tr>
<td>2.</td>
<td>Gas Advance</td>
<td>2000.00</td>
</tr>
<tr>
<td>3.</td>
<td>Contingency (Non-Refundable)</td>
<td>2000.00</td>
</tr>
<tr>
<td>4.</td>
<td>Mess Security (Refundable / Adjustable)</td>
<td>2000.00</td>
</tr>
<tr>
<td>5.</td>
<td>Hostel Card &amp; Student Affidavit</td>
<td>200.00</td>
</tr>
<tr>
<td>6.</td>
<td>Internet Charges (Non-Refundable)</td>
<td>2400.00</td>
</tr>
</tbody>
</table>
7 HOSTEL GATES TIMINGS
7.1 Following timings will be observed for boys hostels.

<table>
<thead>
<tr>
<th>Season</th>
<th>Opening gate Time</th>
<th>Closing gate Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter</td>
<td>7:00 A.M</td>
<td>10:00 P.M</td>
</tr>
<tr>
<td>Summer</td>
<td>6:00 A.M</td>
<td>11:00 P.M</td>
</tr>
</tbody>
</table>

7.2 A Boarder card will be issued by the provost office to the residents. All the students are subject to keep the Boarder card with them in the hostel and university premises. This card will serve as a proof of a student's identity as a Boarder. No student will be allowed entry into the hostel without his Boarder Card.

8 NOTICES & WALL CHALKING
No resident will be allowed to paste or exhibit any notice printed/hand written or other material, in writing anywhere in the hostel except those duly signed by the hostel warden; no resident student is allowed to engage in wall chalking inside the hostel premises. Any violation of this rule is subject to strict disciplinary action.

9 COMPLAINTS
All complaints about matters relating to the hostels shall be reported to the warden of the hostels. Students must never take matters into their own hands, otherwise they'll be held liable for strict disciplinary action.

10 UTENSILS, FURNITURE AND ELECTRIC INSTALLATIONS.
10.1 Residents are not allowed to take utensils from the dining hall/hostel mess and furniture from common room to their rooms or other hostels. Residents are not allowed to move any hostel furniture or other items from their designated places. Any violation will be subject to strict disciplinary action.

10.2 Every Resident of the hostel will be provided with a bed. A table and a chair will be provided on room basis. He/she will be responsible for any loss or breakage thereof. Residents who willfully destroy or damage any hostel property shall pay for damages and will be heavily fined.

10.3 All rooms of hostels have necessary electric fittings. Student/s residing in these rooms shall be responsible for the proper use and safety of these fittings.

11 COMMON ROOM
11.1 This hostel shall have a Common Room Committee comprising of three to five resident students of that hostel and shall be appointed by the concerned Warden. The Committee will look after the affairs of the Common Room under the supervision of the hostel warden.

11.2 The Resident Warden shall take actions to provide residents with newspapers, magazines, material for indoor games and fulfill other maintenance requirements of the hostel. These
needs shall be met through the contingency fund of the hostel. The Resident Warden shall determine the appropriation of contingency funds for these purposes.

11.3 Film shows are not allowed inside the hostels. Special permission of the Provost must be sought for the arrangement and use of microphones in any function whatsoever inside the hostel premises. Non residents shall not be allowed to enter and participate in any activity inside the hostel premises without the prior permission of the warden. No professional artist shall be invited to perform inside the hostel premises.

11.4 Social and cultural activities like indoor games, dramas, debates etc. can be arranged by resident students in the hostel from time to time with the permission of the Resident Warden. The Resident Warden shall decide the fate of such requests through consultation with the Senior Warden and the Provost.

12 HOSTEL STAFF

12.1 Private/personal servants are not allowed in hostels. Every hostel is manned with designated staff to look after the needs of resident students e.g. bearers, water carriers, sweepers and gardener etc. The hostel staff is answerable to the warden of the hostel. Any complaint against the staff should be communicated to the warden of the hostel in writing. Staff is required to serve the resident students inside the hostel premises according to the duties assigned to them by the hostel administration.

12.2 Misbehavior by the resident students with the hostel staff is subject to strict disciplinary action against the perpetrators.

13 PROHIBITION OF VALUABLES

13.1 The resident students are not allowed to keep valuable items like car, motorcycle, VCR, VCP, Video Camera, T.V Set, gold, expensive mobile phones, large sum of money etc. The hostel administration shall bear no responsibility in case of any loss or theft.

13.2 Resident students are allowed to keep computers, Laptops without external speakers/woofers in their rooms at their own risk for educational purposes only. The hostel administration shall bear no responsibility in case of any loss or theft.

14 REGULATIONS FOR M.Sc STUDENTS

M.Sc students can avail hostel boarding facility for maximum of three (03) years.

Ph.D. students can avail hostel boarding facility for maximum period of four (04) years.

15 CLOSURE OF HOSTELS

The university hostels shall remain closed during the vacations. All resident students shall be required to
vacate the hostels except those who are in examination or have enrolled in summer semester. The administration may provide an alternate arrangement for those who are in examination or enrolled in summer semester. Foreign students may be allowed to stay in their hostel during vacations.

16 **Guests**

Boarder students will not be allowed to invite female guests for casual meals or for night stay without the prior permission of the hostel warden/Provost.

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**A: REGULATIONS FOR HOSTEL WARDEN**

<table>
<thead>
<tr>
<th>No.</th>
<th>Violation</th>
<th>Penalty</th>
</tr>
</thead>
</table>
| 1.  | Violation of Hostel Rules or Disobeying the orders of Hostel Administration | First time: Fine upto a maximum of Rs. 5000/-  
Second time: Cancellation of Hostel Privilege for next sessions and/or expulsion from hostel. |
| 2.  | Using Electric Heaters/Air Conditioners                                   | First time: Fine upto a maximum of Rs. 5000/- and recovery of estimated electricity charges alongwith confiscation of the appliances  
Second time: Cancellation of Hostel Privilege for next sessions and/or expulsion from hostel. |
| 3.  | Installing internal locks in the allotted rooms                           | Fine upto a maximum of Rs. 5000/-                                                               |
| 4.  | Playing games in hostel lawns or corridors                                | Fine upto a maximum of Rs. 5000/-                                                               |
| 5.  | Smoking in hostel premises, sleeping in prayer hall or common room/study room and any matter of this nature | Fine upto a maximum of Rs. 5000/-                                                               |
| 6.  | Keeping non-residents in the room                                         | Fine upto a maximum of Rs. 5000/- and cancellation of hostel privilege for next sessions and/or expulsion from hostel. |
### Hostel Regulations

#### B: REGULATIONS FOR HOSTEL DISCIPLINE COMMITTEE

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Designation</th>
<th>Name</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Provost, University Hostels</td>
<td>Engr. Feroz Din</td>
<td>091-9216796-8</td>
</tr>
<tr>
<td>2</td>
<td>Assistant Provost, University Hostels</td>
<td>Mr. Abdul Ghafar Khan</td>
<td>091-9222223</td>
</tr>
<tr>
<td>3</td>
<td>Researchers Hostel Hayatabad Warden Caretaker</td>
<td>Engr. Zubair Ahamd Khan Mr. Tariq Amin</td>
<td>091-9219010</td>
</tr>
</tbody>
</table>

1. Keeping non-residents in hostel room
   - First time: Fine upto a maximum of Rs. 40,000/-
   - Second time: Cancellation of Hostel Privilege for next sessions and/or expulsion from Hostel.

2. Keeping arms, explosives, intoxicants, and drugs or anything alike.
   - Fine upto a maximum of Rs.40,000/- and cancellation of hostel privilege for next session and/or expulsion from hostel.

   - Fine upto a maximum of Rs. 20,000/-

4. Misbehavior with Hostel Staff or Administration or fellow students.
   - Fine upto a maximum of Rs. 40,000/- and/or expulsion from Hostel and/or cancellation of hostel privilege for next sessions.

5. Invitation to any political figures, scholar or any individual for any speech, lecture, sermon or to circulate any unpublished or published material for this purpose inside or outside the hostel. Pasting posters/notices etc. without the written permission of hostel administration and/or wall chalking and such other activities.
   - Fine upto a maximum of Rs. 40,000/- and/or expulsion from hostel and/or cancellation of hostel privilege for next sessions.

6. Damaging/theft or misuse of hostel property and hostel card
   - Recovery of loss and Fine upto a maximum of Rs. 40,000/- and/or expulsion from hostel and/or cancellation of hostel privilege for next sessions.

7. Subletting of one seat or room to outsiders
   - Cancellation of Hostel seat and fine of Rs. 10,000/- to 20,000/- for subletting a seat and fine of Rs. 20,000/- to 40,000/- for subletting a room.

8. Willful absence from HDC meeting by a Student
   - A fine of upto Rs. 10,000/- for the first time and cancellation of hostel seat and exparte action.
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