POSTGRADUATE PROSPECTUS 2016-17





University of Engineering & Technology, Peshawar





P O S T G R A D U A T E

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In today's knowledge led world, it is imperative that we have robust knowledge-generation and knowledge-transfer mechanisms in place so that economic development needs are efficiently catered for by our output from higher education institutions. I am happy to say that the University of Engineering and Technology, Peshawar is continuously striving and succeeding in meeting these challenges.

UET Peshawar has obtained a good place in HEC's ranking; while this is commendable, but being a graduate of this institution I would like not only a good place but rather the top place in the universities. This success has been possible for a myriad of actions but the fundamental reason is that UET attracts the best students, who challenge a very competent faculty to perform at a much higher level. This improves standards all around, including excellent research publications.

I am glad that Center for Advanced Studies in Energy, Peshawar (CAS-EP) has been officially declared as think-tank by the Khyber Pakhtunkhwa Government. This state-of-the-art Center will address indigenous energy problems, and come up with indigenous solutions and will help the government to frame effective policy for energy sector.

I hope you are one of the fortunate ones that make it to UET. Please be cognizant of the onerous responsibility this places on you, and therefore, single mindedly concentrate on your studies to make us, and your parents, proud of your achievement.

Iqbal Zafat Jhagra Governor Khyber Patkhtunkhwa



Message from the Vice Chancellor

Welcome to the first portal of UET Peshawar, i.e. the Prospectus 2016-17. This document describes our university that include academic programs, admission criteria, rules and regulations. Please read through the Prospectus very carefully, especially sections dealing with "conduct and discipline", "hostel accommodation" and "fee structure". Getting into UET Peshawar is a great privilege and you must appreciate this. With a robust infrastructure and a highly qualified faculty, UET is among the top universities in its category.



Since we have 16 academic degree programs spread over 7 campuses and sub-campuses, admission into a program of your choice needs carefully filling out the application forms. You will need to prioritize your choices, both according to discipline and campus. Once the system places you according to your prioritized choices purely on merit, no changes can be made later!

At UET Peshawar, we have zero-tolerance for politics on campus. Please understand that any

violation in this respect will automatically initiate action leading to punishment. This policy is sacrosanct, and if you harbour any inclination for such activities, UET Peshawar is not for you!

We at UET are dedicated to inculcate different graduate attributes including engineering knowledge, possible analysis, design solution, usage of modern tools and engineering ethics. You will be passed through a rigorous process with continuous objective base assessment to become well rounded engineers. Besides solid academic content, we encourage students to take part in extra-curricular activities in various clubs and student societies, job-fairs, open house and project expos. This will hone your communication entrepreneurial.

It is our ardent endeavour to ensure that you reach your full potential as a productive member of society. With our guidance and mentoring, and your cooperation, I can assure you that time at UET Peshawar will be the best four years of your life.

God bless you all.

Prof. Dr. Iftikhar Hussain Vice Chancellor, UET Peshawar

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ALUMNI ASSOCIATION

Juiversity of Engineering & Technology, Peshawar is pleased to announce establishment of Alumni Association. Membership forms are available online at UET's website:

www.uetpeshawar.edu.pk

Engineers who graduated prior to 1980, from the erstwhile Engineering College, Peshawar University, are also eligible to apply for membership



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CONTACT US

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.

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: 091-9216081

E-mail: khanshahzada@uetpeshawar.edu.pk

www.uetpeshawar.edu.pk

UET 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 Admissions

The Directorate of Admissions is responsible for the student admissions information; provides specific and general information to prospective students round the year. Contact: 091-9216784 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: 091-9216043

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.

CENTERS OF EXCELLENCE & SKILL DEVELOPMENT CENTERS

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 Maters' 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-serive 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.

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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 Jewelery 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.



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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

Mardan Campus

As a result of our growth in the last few years, students were offered an option to get admission in other regions of Khyber Pakhtunkhwa. Mardan Campus was inaugurated in 2002, with a spirit to bring engineering education to people at their doorsteps. The campus is spread over an area of more than 22 acres, including a covered area of 190,000 sq ft., consisting of an administration block, academic blocks, recreation centre, a new hostel for boys, and residential facility for faculty.

At Mardan we offer two engineering under-graduate programmes that include Telecomm-unication Engineering and Computer Software Engineering which has been upgraded to postgraduate level and now electrical engineering added too is being offered at undergraduate level. All the laboratories have recently been strengthened with the latest cutting-edge equipment. The everincreasing applications demonstrate that students find programmes offered credible and useful.

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.

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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 engi-neering sciences are offered, and efforts are afoot to consolidate these programmes. Large investment in strengthening laboratories, and upgrading infras-tructure 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 being established on Pabbi-Cherat Road at 11 KM Southwards from GT Road in district Nowshera. Total area of the campus is 402 acres and the total covered area is approximately 1,021,233 sq. ft. with live-in strength of 3,240 students in eight departments. The Campus includes academic blocks, central facilities, amenities, sports & recreational facilities, hostels, staff residences together with infrastructural facilities and a Sewage Treatment Plant.

Having the services of all Ph.D faculty Jalozai Campus will offer education in eight engineering disciplines including Civil Engineering, Electrical Engineering, Mechanical Engineering, Telecommunication Engineering, Computer Science and Information Technology, Chemical Engineering, Petroleum and Gas Engineering and Industrial Engineering out of which five undergraduate programmes i.e civil engineering, electrical engineering, mechanical engineering, industrial engineering and Computer Science & Information Technology (IT) have been started.

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Department of **Agricultural Engineering**

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.

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CHAIRMAN Prof. Dr. Taj Ali Khan Ph.D (UK) PROFESSORS Prof. Dr. Daulat Khan Ph.D (USA) ASSISTANT PROFESSORS Dr. Muhammad Ibrahim Ph.D. (USA) Dr. Zia-ul-Hag Ph.D. (UK) Dr. M. Shahzad Khan D.Engg. (Bangkok) M.Sc. (Pak) Engr. Mahmood Alam Khan Engr. Abdul Malik M.Sc. (Pak) Engr. Khurram Sheraz M.Sc. (Pak) LECTURERS Dr. Muhammad Ajmal Engr. M. Hamed Khan M.Sc. (Pak)

Ph.D (South Korea) 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.

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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. Electric motor characteristics, Water Flow from pipes and pumps testing. Turbine and Propeller Pumps, Submersible pumps, Peripheral pumps, Water System, Pumps selection and maintenance.

AE 5415 APPLIED WATERSHED HYDROLOGY (3)

Hydrologic cycle and its processes, water balance, precipitation types, estimation of precipitation, analysis of precipitation data. Infiltration phenomena, solutions of the Richard's equation, approximate infiltration models. Runoff estimation and hydrograph analysis, Overland flow theory, lateral flow, water storage in the root z o n e. Principles and methods of evapotranspiration. Watershed characteristics, watershed resource management and watershed modeling using computer models.

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)

Water Erosion and sedimentation, Wind Erosion and Deposition, Wind Erosion Control, Predicting Soil loss, Cropping System. Tillage Practices for Conservation, Conservation Structures, Water Conservation, Farm Ponds.

AE 5422 ADVANCED SOIL PHYSICS (3)

Water Erosion and sedimentation, Wind Erosion and Deposition, Wind Erosion Control, Predicting Soil loss, Cropping System. Tillage Practices for Conservation, Conservation Structures, Water Conservation, Farm Ponds.

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 (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, 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

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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 fourbar linkage. Introduction to dynamics, DAlembert 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 AGR-ICULTURAL 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, cuttingthreshing 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 Buckingghan Pi theorem, determination of Pi terms, determination of functions, conditions for function to be a product, conditions for unction 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.

AE5459 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)

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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.

CHAIRMAN

Prof. Dr. Bashir Alam	
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Ph.D. (USA)

PROFESSORS

Prof. Dr. Akhtar Naeem Khan (TI)	Ph.D.(USA)
Prof. Engr. Amjad Ali	M.Sc. (USA)
Prof. Dr. Qaisar Ali	Ph.D. (Pak)
Prof. Dr. Irshad Ahmad	Ph.D. (Pak)
Prof. Dr. Amjad Naseer	Ph.D. (Pak)
Prof. Dr. Muhammad Javed	Ph.D. (Pak)
Prof. Dr. S. Muhammad Ali	Ph.D. (Pak)

ASSOCIATE PROFESSORS

Dr. Muhammad Ashraf	Ph.D. (Pak)
Dr. Khan Shahzada	Ph.D. (Pak)
Dr. Rashid Rehan	Ph.D. (Canada)

ASSISTANT PROFESSORS

Dr. Navid Ahmad	Ph.D. (USA)
Dr. Rawid Khan	Ph.D. (UK)
Dr. Mohammad Adil	Ph.D. (UK)
Dr. Mujahid Khan	Ph.D. (Pak)
Dr. Naveed Ahmad	Ph.D. (Italy)
Dr. Muhammad Fahad	Ph.D (USA)
Engr. Faisal ur Rehman	M.Sc. (Pak)
Engr. Haleema Attaullah	M.Sc. (Pak)
Engr. Tabinda Masud	M.Sc. (Pak)
Dr. Awais Ahmed	Ph.D (Netherlands)
Engr. Mansoor Khan	M.Sc. (Sweden)
Engr. M. Adeel Arshad	M.Sc. (Italy)
Dr. Shahidullah	Ph.D. (Germany)
Dr. Qazi Samiullah	Ph.D. (Pak)

LECTURERS

Dr. M. Sagheer Aslam	Ph.D. (Canada)
Engr. Alamgir Khalil	M.Sc. (Pak)
Engr. Muhammad Fahim	M.Sc. (Pak)
Engr. Sikandar Hayat Sajid	M.Sc. (Pak)
Engr. Arsalaan Khan	M.Sc. (Pak)
Engr. Hizbullah Sajid	M.Sc. (Pak)
Engr. Zain ul Abidin	M.Sc. (Pak)
Engr. Muhammad Rizwan	M.Sc. (Pak)
Engr. Tayyaba Bibi	M.Sc. (Pak)

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, semigovernment 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 in Civil Engineering offers Postgraduate programme in the following areas of specialization.

Master degree in Civil Engineering with specialization in:

- 1. Environmental Engineering
- 2. Water-Resource Engineering
- 3. Structural Engineering
- 4. Geotechnical Engineering
- 5. Transportation Engineering
- 6. Earthquake Engineering
- 7. Construction Project Management

Ph.D. Degree in Civil Engineering

- 1. Structural Engineering
- 2. Water-Resources Engineering
- 3. Earthquake Engineering
- 4. Geotechnical Engineering
- 5. Environmental Engineering

LIST OF APPROVED COURSES

STRUCTURAL ENGINEERING

CE 5IIO ADVANCED STRUCTURAL ANALYSIS-I (3)

Review of fundamental principles of structural analysis. Analysis of complex planar structure using Classical methods like Moment Distribution, Slope-Deflection, Column Analogy, Consistent Deformation. Matrix methods and their applications to simple planar structures.

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)

Analysis of stress and strain. Elasticity and Plasticity, plane stress and plane strain problems, stress functions, two and three dimensional stress problems. Torsion of various shapes members and the associated twist. Energy principles, fracture. Introduction to shell and plate structures.

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; Momentcurvature, 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)

Relationship between the finite element method and the Rayleigh-Ritz method. Derivation of element stiffness matrices. Construction of general stiffness matrices in global coordinates. Problems in plane stress, plates, and shells under static and dynamic loads.

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, Autogeneious 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 dirfusion.

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)

Methods of measurement of stream flow stage discharge relation Unit Hydrograph theory. Transposition of Hydrograph, Synthesis of hydrography from basin characteristics stream flow routing. Flood Frequency analysis. Attenuation of Flood Flows.

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)

Concepts of Fluvial Geomorphology. Stream forms and classification Quantitative response of river systems, Prediction of general river response to change. Applications of quantitative analysis. Application of the concept of the beginning of motion to practical problems. Design of stable channels, permissible velocity and tractive force, method of maximum permissible velocity, method of critical shear stress, the ideal stable cross section.

CE 5128 WATER RESOURCES ENGINEERING (3)

Characteristics of Groundwater, Aquifers, Basic Groundwater Parameters and Laws, Heterogeneity and Anisotropy, Steady State Groundwater Flow, Compressibility of Aquifers, Transmissivity and Strorativity, Radial Flow in

Civil Engineering

Aquifers, Superposition of Elementary Solutions in Groundwater flow, Pumping Near Hydrogeologic Boundaries, Transient Groundwater Flow, Pumping Test analysis, Groundwater Modeling (Based on Finite Element Method and Finite Difference Method).

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

ENVIRONMENTAL ENGINEERING

CE 5140 WATER SUPPLY ENGINEERING (3)

Forecasting population and water consumption Sources and Yields. Rainfall, runoff and river flows. Improvement and collection of surface water. Ground water collection. Storage and distribution. Analysis of net-works. Quality and standards for various purposes. Treatment process; Clarification, filtration, disinfection and miscellaneous water treatment methods, laboratory experiments in water treatment.

CE 5141 SANITARY ENGINEERING (3)

Sewerage systems, sewage flowrates, wastewater characteristics, sewer construction and maintenance. The design of sewage treatment works: screens, grit chambers, sedimentation tanks, percolating filters, activated sludge systems and chemical treatment. Sludge treatment, digestion and disposal, stream pollution and self-purification. Laboratory experiments in sewage treatment.

CE 5142 CHEMISTRY AND BIOLOGY OF WATER & SEWAGE (3) Basic concepts from qualitative, quantitative, organic, physical and biochemistry. Sampling and examination procedures. Water and wastewater characteristics. Sewage treatment, Standards for raw and treated waters.

CE 5143 PUBLIC HEALTH ENGINEERING (3)

History of environmental engineering, food and water sanitation, air sanitation, refuse collection and disposal, diseases, plumbing, air condition, stream sanitation studies, major industrial wastes and their treatment.

CE 5144 SOLID WASTE MANAGEMENT (3)

Basic concepts in approaching and solving solid management problems. Health significance, collection, transport and various ways of disposal including incineration, sanitary land fill, composting, recovery and re-utilization.

CE 5145 AIR POLLUTION AND CONTROL (3)

Classification and sources of air pollution, air composition, types of air pollutants and their concentrations, ambient air standards, principles of meteorology and diffusion of pollutants and their models, stationary and moving sources emission factors, emission inventories; effects on human beings, plants, properties, air pollution episodes,

¹⁵ UET Postgraduate Prospectus 2016-17

global effects control of particulate and gaseous pollutants, control techniques and equipment; standard methods for sampling and analysis.

CE 5146 WATER QUALITY MODELLING (3)

Basic concepts of modeling, water quality criteria and standards, relationship of water quality to water uses, sources of pollution and types of wastes, general mathematical formulations and water quality modeling, BOD and Dissolved Oxygen models, Bacterial decay models data requirements in modeling.

CE 5147 ECONOMICS AND PLANNING OF ENVIRONMENTAL HEALTH ENGINEERING PROJECTS (3)

General principles of project analysis. demand. excess capacity. principles of engineering economics. mathematics of economic analysis. discounting techniques capital costs. operation and maintenance costs. cost and benefit curves. optimality. conception. Costing and evaluation of alternatives in water supply. sewerage and water and wastewater treatment projects.

CE 5148 PRINCIPLES OF WATER AND WASTEWATER TREATMENT PROCESSES (4)

Fundamentals of process engineering. Reactions and reaction kinetics. Mechanisms of mass transport. Reactor theory. ideal reactors. Non-ideal flow in reactors theory and application of physiochemical processes for the treatment of water and wastewater including sedimentation. Adsorption. Principles of biological treatment. Bacterial growth kinetics. Kinetics of Sub strate utilization. Attached and suspended growth processes.

CE 5149 INDUSTRIAL WASTE WATER POLLUTION, CONTROL AND MANAGEMENT (3)

Effect of industrial waste on streams and wastewater plants. Stream protection measures. Computation of organic waste loads on streams; stream sampling. Strength Reduction. Neutralization. Equalization and proportioning. Removal of Suspended and Colloidal solids. inorganic Dissolved solid. Application of biological treatment to industrial wastewaters. Treatment and disposal of Sludge solids.

Application of UASB technology to agro-based industrial wastewater treatment. Waste minimization and resource recovery from local industries. Environmental Quality Standards in Pakistan.

CE 5150 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) (4)

An Introduction to E1A. Definitions: Environmental Inventory. Environmental Assessment. Environmental impact Statement. Methods. Techniques and Procedures of EIA. Format for the organization of EIA Report. Design of an EIA. Legislative and Regulatory Consideration. Quality of Life Values components of EIA process. Assessment

Civil Engineering

of Impacts on water resources. Modelling Impacts of waste discharges on water quality in Rivers. Estimating air Quality Impact. Impacts of Sanitary Land Fills. Case studies of EIA: Thermal power plants. Cement plants, Urbanization and Industrialization in Pakistan.

CE 5151 ENVIRONMENTAL POLLUTION CONTROL (3)

Pollution of Water. Land and Air: Causes and effects. health and ecological considerations. Over view of the Environmental Profile of Pakistan. Environmental authorities and jurisdiction. Environmental Regulations and Standards: Pakistan & International, The Pakistan National Conservation Strategy. The Sarhad Provincial Conservation Strategy. Environmental quality objectives, criteria and standards of pollution Control. Noise and Marine pollution and control.

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

CONSTRUCTION PROJECT MANAGEMENT

CE 5172 PROJECT MANAGEMENT THEORY, PRACTICE & APPLICATION (3)

Construction project management concepts, standards and services, Organizational structures for the delivery of project management services, Management strategies for clients and stakeholder briefing, Issues related to the management of the construction project design process and budget setting, Project manager's role and responsibilities, Managing project scope, Managing design, Managing cost, Managing time, Managing Quality and Safety. Functions of Management, Identifications of Projects, Types of Projects, Life Cycle of Projects, Key Players of The Projects. Alignment of Projects With Organizational Strategies.

Recommended Books

- Kerzner, H. "A systems approach to planning, scheduling and controlling" Fifth Edition, 2004. Van Nostrand Reinhold ISBN 0-442-01907-6
- "Association for Project Management Body of Knowledge", The Association for Project Management Thornton House, 150 West High Wycombe Road, High Wycombe, Buckinghamshire,

CE5173 PROJECT PLANNING, SCHEDULING AND ESTIMATING (3)

Issues affecting international construction organizations, Pre-tender Planning, Pre-Contract Planning, Planning Techniques, Resource Analysis, Short Term Planning, Computer-Aided Planning, Project Monitoring and Control, Contract Documentation, Managing the Design Process, Pre-Contract Estimating, available planning techniques, contract documentation and cost estimates. Recommended Books

- 1. Smith, N,J, Engineering Project Management, Blackwell Publishing, 2002.
- 2. Code of estimating practice. in RICS, M & E Procurement Guide., 7th Edition, CIOB / Longmans., 2009

CE 5174 CONSTRUCTION FINANCIAL MANAGEMENT (3)

Company Level Analysis [setting up corporate strategies, the production of company budgets and the production of financial plans and developing income streams], Project Level Financial Management [Cash Flow and Cost Control, Corporate Analysis -accounts, ratios and their potential impacts upon future corporate strategy] and Investment & Development Appraisal Techniques [the use of financial techniques to appraise alternative investment decisions and life cycle costing and the optimum replacement age for a variety of different assets]. Taxation System, Financial Statements and Elements Of Financial Statements, Balance Sheets, Means Of Financing,

Recommended Book

Journal of Construction Management and Economics

CE5175 MANAGEMENT AND PROFESSIONAL DEVELOPMENT (3)

This module will be based on the framework provided by the Institution of Civil Engineers' [UK] Management Development in the Construction Industry, covering topics of Corporate Mana-gement; Business Management; Financial and Management Systems; Promotion and Business Development; Communications and Presentations; The Client and Relationships; Respect for People; Project Management; Professional, Commercial and Contractual Practice; Information and Communication Technology; Health, Safety and Welfare and The Construction Profession and Society.

Recommended Book

"Management Development in the Construction Industry", Institute of Civil Engineering [UK], Thomas Telford, 2004.

CE 5176 VALUE & RISK MANAGEMENT (4)

Value and risk management and the construction procurement process, An Introduction to Value Management, Value Engineering [VE]- Function Analysis and other VE tools, Risk, uncertainty and the construction industry, Risk and procurement, The Risk Management framework., Sources, events and effects of project risk, Tools and techniques of Risk Management, Risk response and mitigation, Client Briefing, A Review of North American Practice in Value and risk management. Managing International Risks.

Recommended Book

Kelly, John, Male, Stephen, Graham, Drummond, Value Management of Construction Projects, Blackwell Science 2002

CE5177 HUMAN RESOURCE MANAGEMENT IN CONSTRUCTION (3)

Challenges of managing people in construction; organization and management theory; Human Resource Management [HRM] theory; strategic HRM approaches; operational HRM approaches; employees relations; employee empowerment; diversity and work/life balance; employee welfare; strategic human resource development and employment legislation.

Recommended Books

- Harris, F. & McCaffer, R., Modern construction management., 4th Edition, Blackwell science, 1995 Neale, R. H. & Neale, D. E., Construction planning., Thomas Telford, 1989
- 2. Loosemore, M., Dainty, A and Lingard, H., Human resource management in construction projects: strategic and operational approaches: Spon Press, London, 2003

CE 5178 PROJECT MANAGEMENT – STRATEGIC ISSUES (3)

Lean Construction; Process Mapping and Lean Processes; Planning for Lean construction; Performance Measurement and Benchmarking; Leadership and Influence; Supply Chain Management and Strategic Partnering Lessons learned from other industries. Knowledge Management.

Recommended Books

1. Buchattaa D & Huczynski A, 2005. Organizational

Behaviour: An Introductory Text. Prentice Hall, Third Edition.

2. Dingle J, 2005, Project Management: Orientation for Decision Makers, Arnold.

CE 5179 MANAGEMENT INFORMATION SYSTEMS FOR CONSTRUCTION PROJECT MANAGEMENT (4)

Information Management within the construction organization. The classification of Information Systems: Personal Information Systems. Managers' requirements: support for planning, control, and decision making at an operational and executive level. Modeling information flow. Information Technology: hardware, software, and communications equipment. The impact of Electronic Information Exchange, Multi-Media, Knowledge Management, Intelligent Systems and e-Business. The development of a Management Information Systems [MIS] strategy for an organization. Systems development. Systems selection and acquisition and implementing new systems within construction organizations.

Recommended Books

- Laudon, K. C. & Laudon, P. L., Management information systems, organization and technology., 6th End, Prentice-Hall, New Jersey, USA, 2000
- Paulson, Boyd, C. Jnr., Computer applications in construction., McGraw-Hill International editions, McGraw-Hill Inc., New York. USA., 1995

CE 5116 RESEARCH, INNOVATION AND COMMUNICATIONS (3)

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

- aoum, S. G., Dissertation research and writing for construction students, 1st Edition, Oxford : Butterworth-Heinemann, 2004
- 2. Fellows, R. F., Research methods for construction, 1st Edition, Oxford : Blackwell Science, 2003
- 3. Easterby-Smith, M., Thorpe, R. & Lowe, A., Management research: An introduction., Sage Publications, London, 1991.

CE5117 ENGINEERING CONTRACTS AND TENDERING PROCESS (3)

Engineering Contracts

The reasoning of Contracts, the Law of Contracts, Labor Laws, Types of Engineering Contract Administration, Litigation, Equity, Arbitration, Claims Preparation and Dispute Resolution. 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

- 1. Abbett, R.W. (1960), Engineering Contracts and Specifications 3rd Edition, John Wiley and Sons, Inc.
- Smith G.R., (2003). Contracts and Claims. In: Chen, W.F. and Richard Liew, J.Y., The Civil Engineering Hand Book. 2nd Edition CRC Press LLC.
- CE 5190 SPECIAL TOPICS (UPTO 3 CREDIT HOURS)
- CE 5199 MASTER'S THESIS (6)

TRANSPORTATION ENGINEERING

CE 5180 ADVANCED PAVEMENT DESIGN (3)

Pavement types, Wheel loads and design factor, Stresses in Flexible Pavements, Stresses in Rigid Pavements, Vehicle and Traffic Characteristics, Climate, Environment, The Economic Factor, Design Strategies, System Analysis, Design of Flexible Airport Pavements, Design of Flexible Highway Pavements, Design of Rigid Airport Pavements, Design of Rigid Highway Pavements, Modern Concept of Pavement Designs, ELSYM5, CHEVRON, BASAR Computer packages. Recommended Book: Principles of Pavement Design by E.J. Yoder, M.W. Witzak, Publishers: John Weley.

CE 5181PAVEMENT MANAGEMENT AND REHABILITATION (3)

Procurement Process

Civil Engineering

Pavement Evaluation and Performance: General Concept of Pavement Evaluation, Evaluation of Pavement Performance, Evaluation of Pavement Structural Capacity, Evaluation of pavement Distress, Condition Surveys, Evaluation of Pavement Safety, Design Alternatives; Analysis, Evaluation and Selection.

Implementation: Implementation of PMS, Construction, Maintenance and Rehabilitation, Feedback data system, Examples of Working Design and Management. Future Research Needs.

Recommended Book

Pavement Management Systems, By Haas and W. Ronald Hudson., Publishers: John Weley

CE 5182 ADVANCE PAVEMENT MATERIALS (3)

Soil Classification, Material Characterization, Soil and Base Stabilization, Sub grades, Bases and Sub bases, Bituminous Surfaces, Material Variability, Asphalt Concrete Mix Design. Physical and mechanical properties of asphalt and Portland cement concrete mixtures, Portland Concrete Mixture Design.

Reference Literature: ASTM, AASHTO & other standards on Materials. This course would mainly consist of seminars, term projects, lab tests and Research paper Discussions.

CE 5183 HIGHWAYS GEOMETRIC DESIGN (3)

Highway function, Design controls & criteria, Elements of design, Cross section Elements, Local Roads & Streets, Collector Roads & Streets, Rural & Urban arterials, Freeways, At Grade Intersection, Grade Separation & Interchanges, Practical problems, Roadside design.

Recommended Book

A Policy on Geometric Design of Highways & Streets (AASHTO)

CE 5184 AIRPORT DESIGN (3)

The structural and Organization of Air Transport, Forecasting Air Transport Demand, Characteristics of Aircraft as they Affect Airports, Airport Master's Planning, Air Traffic control, Lighting and Signing, Airport Capacity and Configuration, Geometric Design of the Airside, Passenger Terminal, Air Cargo Facilities, Airport Drainage and Pavement Design, Airport Access, Requirements of V/STOL system, Environmental Impact of Airport.

Recommended Book

Airport Engineering, By Norman Ashford & Paul H. Wright. Publishers: Wiley Intersciences.

CE 5185 TRAFFIC ENGINEERING & PRACTICE (3)

The road user, vehicle, roadways and geometrics design, Introduction to Urban Transportation Planning, Origin and Destination Studies, Highway Economy Studies, Travel Time and Delay Studies, Spot speed Studies, Volume Studies.

Traffic Theory: Flow & Control.Highway Capacity: Introduction, Freeways and Expressways, Urban Streets and Arterials, Rural Highways without excess control.Pedestrian Studies, Parking studies, Accident Studies, Traffic laws and Ordinances, Traffic Control Devices, Traffic Sign and markings, Traffic Signals, Street and Highway lightings, The Intersection (Control measures), Coordination of Signal System (Control measures), Speed Control & Zoning, One way streets, unbalanced flow and reserved transit lanes, Curb Parking Controls, Special Application of Traffic Control to Limited Access Facilities, Applications for Highway safety, TRANSYT 7F Application.

Recommended Book

Traffic Engineering (Theory & Practices), By Louis J. Pignataro, Publishers: Prentice Hall.

CE 5186 TRANSPORTATION PLANNING & MODELING (3)

Introduction, Demand Theory, Transportation supply, Urban passenger Travel Demand, Analysis of Travel Choices, Trip Distribution analysis, Mode & Route Choices, Intercity Passenger Travel Demand, The Demand Air Transportation, Commodity Transport Demand, Computer Application of "QUICK RESPONSE SYSTEM".

Recommended Book

Transportation Demand Analysis, By Abid Kanafani. Publishers: McGraw Hill.

CE 5187 INFRASTRUCTURE MANAGEMENT (3)

Introduction, Framework for Infrastructure Management, Planning, Need, Assessment & Performance Indicators, Data Base Management & Decision Support System, Inventory, Historic & Environmental Data.

In service Monitoring & Evaluation Data, Uses of Monitoring Data & Examples of In Service Evaluation, Performance Modeling & Failure Analysis, Design for Infrastructure Service Life, Construction, Maintenance, Rehabilitation & Reconstruction Strategies, Including Operations, Dealing with New or Alternate Concept, Maintenance, Rehabilitation & Reconstruction Policies and Treatment Alternatives, Life Cycle Cost and Benefit Analysis, Prioritization, Optimization and Work Program, Concept of Integrated Infrastructure Management System.

Visual IMS: A working Infrastructure Management System and Application.

Benefits of Implementing IMS, Future Research Needs, Practical Application.

Recommended Book

Infrastructure Management, By W. Ronald Hudson, Ralph Haas, Waheed Uddin, Publishers: McGraw Hill.

CE 5188 TRAFFIC IMPACT & SAFETY STUDIES (3)

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,

Geotechnical Properties of earthen/soil material for embankments, suitability of soil/rock for embankments, stability of slopes, theory of compaction, Methods of determining compaction, safe side slopes based on geotechnical properties of cut material, Retaining structure for highway embankments.

- 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 coffer dam, 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 responses to impulse load, dynamic properties of soil and methods for their determination, design procedure for foundation subjected to dynamic forces.

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

EARTHQUAKE ENGINEERING

CE 5113 DYNAMICS OF STRUCTURES-I (3)

Introduction to SDOF, MDOF and Continuous Systems. Formulation of equation of motion for SDOF systems, Principles of Analytical Mechanics, Response of SDOF and continuous systems to Damped and Un-damped, free, forced harmonic and general dynamic loading and transient response. Approximate and numerical methods for analysis of SDOF and continuous systems. Analysis of response in the frequency domain, Wave propagation analysis.

Recommended Books

- 1. Dynamics of Structures 2nd Edition by Jagmohan L. Huimar
- 2. Vibration Problem in Structures Practical Guidelines by Hugo Vachmann, Lorrenz Steinbeisser
- 3. Structural dynamics, theory & computation by Mario Paz, 5th Edition, Springer publications

4. Mechanical vibrations by S.S. Rao, 4th edition, Prentice-Hall Publishers.

CE 5157 EARTHQUAKE ENGINEERING – I (3) (PRE-REQUISITE CE 5113)

earthquake excitation, Response quantities, Response history and Response Spectrum concepts, Pseudo velocity and acceleration, Design spectra, Effects of yielding, Relative effects of yielding and damping, Inelastic design spectrum, Structural dynamics in building codes, Evaluation of building codes, Introduction to Base isolation and Structural Controls in buildings

Recommended Book

Dynamics of structures by Anil K. Chopra, 2nd Edition, Prentice-Hall Publishers

CE 5158 DYNAMICS OF STRUCTURES-II (4) (PRE-REQUISITE CE 5113)

Part-1: Formulation of equation of Motion for MDOF systems. Free vibration response of MDOF systems, Numerical solution of the eigen problem, Forced dynamic response of MDOF systems, Mode superposition method, effect of support excitation, forced vibration of unrestrained systems, Approximate and Numerical Methods for Analysis of MDOF systems, Raleigh-Ritz method, Direct Integration of the equation of motion. Analysis in the frequency domain. Analysis of Non-linear problems in structural dynamics.

Civil Engineering

Part-II: Effect of wind on bridges, suspension systems and tall buildings using random vibration theory, Application to problems in material behavior such as fatigue in cables, hysterisis loops in concrete and steel, and damping in structural systems.

Recommended Books

- 1. Dynamics of Structures by Jagmohan L. Huimar, 2nd Edition
- 2. Structural Dynamics by Mario Paz
- Wind's effects on structures: Fundamentals & applications to design by Emil SImiu, Scanlan, John willy & sons.
- CE 5159 EARTHQUAKE ENGINEERING II (4) (PRE-REQUISITE CE 5157)

Modal analysis, Multistory buildings with symmetric and un-symmetric plans, torsional response of symmetric-plan buildings, multiple support excitation, Earthquake response and design of multistory buildings, Modal contribution factors, Earthquake response of inelastic buildings, Allowable ductility and ductility demand, Active and Passive control systems in structures, Recent advances and Innovation in earthquake engineering, projects

Recommended Book

Dynamics of Structures by Anil. K. Chopra

CE 5160 ENGINEERING SEISMOLOGY (4)

Seismological and tectonic processes causing earthquake occurrence. Earthquake parameters. Seismic effects parameters. Regional seismic effects. Seismological mathematical models. Local soil effects. Geotechnical and Geophysical investigations. Soil models. Response spectra. Seismic hazard analysis. Seismic zoning and micro zoning. Seismic risk. Seismic design parameters.

Recommended Books

- 1. An Introduction to Seismology Earthquakes, and Earth Structure by Seth Stein and Michael Wysession
- 2. Earthquake, by Bruce Bolt, 5th edition, Freeman publishers

CE 5161 DYNAMIC SOIL STRUCTURE INTERACTION (4) (PRE-REQUISITE CE 5113)

Dynamic properties of soils and their determination. Response of soil media to earthquake ground motions. Dynamic instabilities of soils: causes of soil failure during earthquakes, soil liquefaction, soil settlement, landslides and slope instability. Foundation vibration:

vertical, torsional and simultaneous translational and rocking vibration of non-embedded and embedded foundations. Soil-structure interaction effects: model formulation, dynamic properties and response analysis of structures, experimental full-scale testing for 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
- 2. Soil Structure Interaction Analysis by John P. Wolf & C. Zhang, Elsevier science
- 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)

Introduction to physical models in structural engineering, Dimensional analysis and similarity criteria. Elastic and inelastic models, Linear and nonlinear models in earthquake engineering. Shaking tables. Simulation and control of earthquake motion. Collection of data and analysis. Transducers. Quasi-static test of joints, elements and assemblages. Philosophy and principles of testing. Equipment for testing and measurements. Collected data and analysis. Full-scale test of structures. Resonant method. Ambient vibration technique. Equipment for simulation of motion, measurement and analysis. Identified quantities.

Recommended Book

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

CE5163 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
- 4. Concept & application of finite element analysis by Cook, Malkens & Pleshe, 4th Edition, John Willey.

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 structures. Seismic risk analysis and loss prediction: presentation and density distribution of elements at risk, loss prediction potential, loss per elements at risk, cumulative, loss analysis and presentation; seismic risk analysis; optimization of seismic risk, acceptable level of seismic risk. Earthquake disaster management: strategies for earthquake disaster management, pre-disaster, planning for mitigation of seismic risk, post-disaster reduction of earthquake consequences.

Recommended Book

Seismic Hazard and Risk Analysis by Earthquake Engineering Research Institute, USA.

CE 5165 APPLICATION AND DEVELOPMENT OF EARTH-QUAKE CODES (3)

> Introduction. Basic principles and parameters. Review of the earthquake codes in the world practice. Comparison of the seismic forces obtained by different codes. Techniques for developing the national earthquake codes.

Recommended Books

- 1. Pakistan Building code
- 2. UBC code
- 3. EuroCode

- 4. NEHRP Code
- 5. Other relevant code

CE 5166 SEISMIC DESIGN OF CONCRETE AND MASONRY STRUCTURES (4)

Structural design of reinforced-concrete building. Strength and stress characteristics of concrete and reinforced steel for hysteretic behaviors. Basic principles of nonlinear analysis of reinforced concrete cross-section and members subject to bending, axial and shear forces. Nonlinear behavior of the members, components and structures under earthquake conditions. Aseismic design of reinforced-concrete structures with basic principles, calculation and analysis. Frame systems and new structural systems as seismically resistant building structures.

Behavior of masonry buildings during the past earthquakes, characteristics of materials of masonry structures. Seismic resistant design of masonry buildings, Un-reinforced, reinforced and confined masonry.

Recommended Books

- Seismic Design of Reinforced Concrete and Masonry Building by Priestly & T. Paulay, John willey
- 2. Earthquake-Resistant Design of Masonry Buildings by Miha Tomazevic, IC press

CE 5167 SEISMIC DESIGN OF STEEL STRUCTURES (4) (PRE-REQUISITE CE 5153)

Introduction: Seismic design concepts of building codes, Structural steel materials, Analysis and Detailing of Special Moment Resisting Frames: Beam design, Beam-to-column connections, Beam to column panel zones, column design, Behavior and Design of Concentrically Braced Frames: Design philosophy, Hysteretic energy dissipation capacity of braces, Design requirements, Bracing connections design requirements, Columns and beams, Special bracing configuration requirements, Behavior and Design of Eccentrically Braced Frames: Basic concept, EBF and link Behavior, Capacity design of other structural components, Design Examples: Special moment frames (SMF), Special concentrically braced frames (SCBFs), Eccentrically braced frames EBFs)

Recommended Books

- 1. Steel Structure, controlling behavior through design by R. Englekirk, John Willey
- 2. Seismic Design Handbook by Farzad Naiem

CE 5168 ASEISMIC DESIGN OF BRIDGES (4) (PRE- REQUISITE CE 5154)

Seismic performance of highway bridges in past earthquakes. General concept for aseismic design of highway bridges. Code specification and advanced procedures. General requirements. Load combinations and design forces for structural members, foundations and connections. Design displacements. Foundations and abutments. Design of structural members and detailing. Application of modem analysis methods, and advanced capacity design concept for aseismic design of highway bridges. Recent advances in seismic isolation and vibration control systems for seismic resistance improvement of bridge structures.

Recommended Books

- 1. Bridge Engineering Seismic Design by Wai-fah Chen
- 2. Seismic design & retroffiting of bridges by priestlay & sabble, John willey publishers.

CE 5169 SEISMIC DESIGN OF DAMS (4)

Introduction to earth fill, gravity and arch dams. Criteria ensuring static and seismic stability of dam structures under seismic effects. Seismic loads description. Mathematical models for analysis including three media defining hydro technical structures: water fluid dam body. Dam body fluid integration. Application of finite element methods for discretization of dam body and rock mass. Application of contact elements for modeling of dam-rock contact zone. Dam body - rock interaction. Practical examples of estimation of static and seismic stability of dams.

Civil Engineering

Recommended Book

Earthquake Engineering for Large Dams by Priscu 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 5171REPAIR 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
- 2. Concrete Repair Manual Vol. 1 2nd Edition by ACI International
- 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)

Department of **Electrical Engineering**

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 verity 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 system 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 level. 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 indepth knowledge and developing research capabilities among the students.

CHAIRMAN

Prof. Dr. Syed Wagar Shah Ph.D.(UK)

PROFESSORS

Prof. Dr. M. Naeem Arbab	Ph.D. (UK)
Prof. Dr. K.M. Yahya	Ph.D. (USA
Prof. Dr. M. Inayatullah Khan Babar	Ph.D (USA
Prof. Dr. Haseeb Zafar	Ph.D. (UK)
Prof. Dr. Amjad Ullah Khattak	Ph.D. (Pak

ASSOCIATE PROFESSOR

Dr. Tarigullah Jan

Ph.D (UK)

ASSISTANT PROFESSORS

Engr. Gulzar Ahmad	M.S. (USA)
Engr. S.M. Majid Ashraf	M.Sc.(Denmark)
Engr. M. Iftikhar Khan	M.Sc.(Pak)
Engr. Siddique Ali	M.Sc. (Pak)
Dr. Gul Muhammad Khan	Ph.D. (UK)
Dr. Shahid Bashir	Ph.D. (UK)
Engr. M. Usman Ali	M.Sc. (Pak)
Engr. S.M Faheem	M.Sc. (Sweden)

LECTURERS

Engr. Muhammad Amir	M.Phil (UK
Engr. Maha Gul	M.Sc. (Pak)
Engr. Farah Mahmood	M.Sc. (Pak)
Engr. Asiya Jahangir	M.Sc. (Pak)
Engr. Bilal-ur-Rehman	M.Sc. (Pak)
Engr. Salman Illahi	M.Sc. (Pak)
Engr. Uzma Nawaz	M.Sc. (Pak)

Electrical Engineering

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 wellorganized experts in the field of electric power, electronics and telecommunications holds regular meetings with these organization 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 assistace 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, Thyister controlled circuits, Thyrister 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, Sohwartz-Christofell transformation, Relaxation methods, field plotting method, three dimensions fields.

EEP 5210 DIRECT ENERGY CONVERSION (3)

Introduction to specialized electric energy sources e.g. photovoltaic. Thermionic converters, Magnetohydrodynamics generation, fuel cell, windelectric 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, semi conductor, 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

Robert W. Erickson and Dragan Maksimovic, Fundamentals of Power Electronics, Second Edition, Kluwer Academic Publishers, 2001, ISBN 0-7923-7270-0.

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

Robert W. Erickson and Dragan Maksimovic, Fundamentals of power Electronics, Second Edition. Kluwer Academic Publishers, 2001 ISBN 0-7923-7270-0

Electrical Engineering

EEP 5290 SPECIAL STUDIES (3)

INDIVIDUAL STUDIES ON SPECIAL TOPICS.

- EEP 5299 MASTER'S THESIS (6)
- EEP 6299 Ph.D. THESIS (1-9)

COMMUNICATION AND ELECTRONIC ENGINEERING

EEC 5276 DIGITAL COMMUNICATION SYSTEMS (3)

This course is designed to prepare students for engineering work in the industry and for advanced graduate work in the area of digital communications. The course covers concepts and useful tools for design and performance analysis of transmitters and receivers in the physical layer of a communication system. Students will get a chance to implement several of the concept studied in Matlab. Signal and Spectra: Digital Communication Signal Processing, Classification of Signals, Spectral Density, Autocorrelation, Random Signals. Formatting and Baseband Modulation: PCM, Waveform representation of Binary Digits. Baseband Demodulation/Detection: Detection of Binary Signals in AWGN, The matched filter, ISI, Channel Equalization, Eye Patterns Bandpass Modulation and Demodulation/ Detection: ASK, FSK, PSK, QAM, Coherent and non-coherent detection. Synchronization: Phase locked loops, Symbol Timing Recovery Design and performance analysis of a Digital Communication System.

Recommended Book

Digital Communications: Fundamentals and Applications by Bernard Sklar

EEC 5277 WIRELESS COMMUNICATION (3)

This course is designed to prepare students for engineering work in the industry and for advanced graduate work in the area of mobile communications. The course covers concepts and useful tools for design and performance analysis of wireless communication systems.

To achieve the goal the topic 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, Coding and Error Control, Multiple access techniques, 1G, 2G, and 2.5G wireless systems (AMPS, GSM, GPRS, EDGE, etc.), The UMTS network and radio access technology Wireless LANs, IEEE 802.1x

Recommended Books

- 1. T.S. Rappaport, "Wireless Communications: Principles & Practice", Second Edition, Prentice Hall, 2002.
- 2. Simon Haykin & Michael Moher, "Modern Wireless Communications", Prentice Hall, 2004.

EEC 5278 RANDOM SIGNALS AND NOISE (3)

Review Of Probability Theory, Probabilistic Models, Analysis Of Practical Models, Random Signals And Systems, Specifying Random Experiments, The Cumulative Distribution Function, The Probability Density Function Functions Of A Random Variable, The Expected Value Of Random Variables, The Markov And Chebyshev Inequalities, Testing The Fit Of A Distribution To Data Transform Methods.Conditional Probability. Independence Of Events, Multiple Random Variables, Functions Of Several Random Variables, Expected Value Of Functions Of Random Variables, Jointly Gaussian Random Variables, Mean Square Estimation, Sequential Experiments, Vector Random Variables, Independence Of Two Random Variables. Conditional Probability, Conditional Expectation, The Sample Mean And The Laws Of Large Numbers, The Central Limit Theorem. Confidence Intervals. Long-Term Arrival Rates, Convergence Of Sequences Of Random Variables, Definition Of A Random Process.

Recommended Books

- 1. Alberto Leon-Garcia, "Probability and Random Processes for Electrical Engineering", 2nd Edition, Pearson Education
- 2. Papoulis, "Probability, Random variables and Stochastic Processes", McGraw Hill

EEC 5279 STOCHASTIC PROCESSES (3)

To acquaint students with various ways to model stochastic phenomena in dynamic systems. The interplay between the theoretical framework and practical applications is crucial in this course. To achieve the goal the topic that will be covered include: Introduction to Random Processes, Characterization of Random Processes, The Complex Random Processes, Mean, Correlation, and Covariance Functions, The Concept of Stationarity and Ergodicity, Properties of Autocorrelation Function, Properties of

Cross Correlation Function, Periodic Random Processes, Cyclostationery Processes.

Recommended Book

Probability, Random Variable, and Scholastic Processes, 2nd Edition. By Popoulis, McGraw-hill

EEC 5211 SIGNAL DETECTION & ESTIMATION (3)

To acquaint students with various methods to detect and estimate the signal in dynamic systems. The interplay between the theoretical framework and practical applications is crucial in this course. To achieve the goal the topic that will be covered include Introduction to Estimation, Minimum Variance Unbiased Estimation, Kramer-Rao Lower Bound, Linear Estimators, General Minimum Variance, Unbiased Estimation, Best Linear Unbiased Estimators, Maximum Likelihood Estimation, Least Square Approach, Bayesian Estimators, and Elements of Detection Theory

Recommended Books

- 1. Steven M. Kay, Fundamentals of Statistical signal Processing: Estimation Theory, (Prentice Hall 1993.)
- 2. Steven M. Kay, Fundamentals of Statistical signal Processing: Detection Theory, (Prentice Hall 1998.)

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

Computer Networks: A Systems Approach, 3rd Edition by Larry Peterson, Bruce Davie, Morgan Kaufman Publishers, 2003.

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EEC 5282 MOBILE NETWORKING (3)

This course examines mobile data networks, mobility issues in networking and covers fundamentals of mobile network architectures. Another focus of this course is on routing schemes for mobile and nomadic hosts, including Mobile IP, mobile ad hoc network (MANET) protocols, DHCP and IPv6. To achieve the goal the following topics will be explored: Basics of Wireless Networks and Mobile Computing, Mobility Management in Bluetooth PANs, IEEE 802.11 Wireless LANs ,GPRS, UMTS WANs and Wireless ATM. Multiple Access Methods, Mobile IP, Mobile Ad Hoc Networks (MANETs) and Mobility support in DHCP and IPv6.

Recommended Books

- 1. Ad Hoc Networking by Charls Perkins, Ist Edition, Eddison-Wesley.
- 2. Mobile IP by Charlse Perkins, Ist Edition, Prentice Hall.
- 3. Wireless LANs by James T. Geier and Jim Geier, Seceond Edition, SAMS.

EEC 5283 PERFORMANCE EVALUATION AND MODELING OF COMMUNICATION NETWORKS (3)

Modeling simple queues, network of queues, Modeling of packet loss and priority of systems in packet switched network, modeling of data communication networks. Modeling of end- to-end delays in store and forward networks, Modeling of servers, servers with vacations and cyclic servers (token ring).

EEC 5212 DIGITAL SIGNAL PROCESSING (3)

Introduction scope, Comparison between continuous time signal and discrete time sequences, properties of LSI system, difference equations, causality, stability.

Discrete Fourier transforms. Applications of DSP. Digital signals, systems and convolution. Fourier transform and frequency response, sampling. discrete time Fourier transform, DFT and FFT algorithms, Z-transform, FIR and IIR filters and their implementations, FIR filter design methods, IIR filter design methods

Recommended Book

Discrete Time Signal Processing By Alan V. Oppenheim, Ronald W. Schafer, John R. Buck

EEC 5213 ADVANCED DIGITAL SIGNAL PROCESSING (3)

This course provides an in depth knowledge of the theory and application of DSP and provide a solid foundation in the basics of DSP related to both signal analysis, system analysis and design. To achieve the objective the following topics will be explored: Sampling of continuous-time signal and sampling rate conversion: the sampling theorem and some of its variations, reconstruction formulae, application to the discrete-time processing of

continuous-time signals, sampling rate conversion in mutilate systems. Transform analysis of LTI systems: pole-zero representation for rational systems, study of various important systems including all-pass system, inverse system and minimum-phase system. Structure for discrete-time systems: signal flow graph representation, basic structures for FIR and IIR systems (direct forms, parallel, cascade, etc.) transposition theorem, effects of coefficient quantization on frequency response, round-off noise in digital filtering. Filter design techniques: filter design as a numerical approximation problem, transformation techniques for the design of IIR filters, FIR filter design by windowing. Discrete Fourier transform (DFT): definition and properties of the discrete Fourier series, definition of the DFT and its properties, application to linear convolution. Computation of the DFT: the computational problem, most commonly used Fast Fourier Transform (FFT) algorithms (radix-2, decimation- intime, decimation infrequency,etc.), possible generalizations and specializations

Recommended Book

Discrete Time Signal Processing By Alan V. Oppenheim, Ronald W. Schafer, John R. Buck

EEC 5214 ADAPTIVE FILTERS (3)

Review of discrete time stochastic processes, Wiener Filters Steepest Descent Method, Theory of LMS algorithm, Recursive Least Square (RLS) algorithm, Kalman Filtering Applications: Line Echo Cancellation, adaptive beam forming, Kalman filter based estimation and measurements

EEC 5223 ADVANCED DIGITAL DESIGN (3)

This course is designed to introduce engineers and designers advanced digital design concepts. The students are taught different steps in the design flow of VLSI IC circuit designing using HDLs. The main topic covered during the course are: High-level digital design methodology using Verilog, Reusable Methodology, HDL coding for synthesis, FPGA based Digital Design, XILINX ISE 6.1i synthesys and implementation tool workshop, Datapath and Controller Design Partitioning, Design of Datapath Units, Algorithmic state machine based design, Time shared and pipeline architectures, Digital design of high speed computational unit, Single Cycle and Pipelined Processor, and VLIW and SuperScalor Architecture.

Recommended Books

- 1. Advanced Digital Design with the Verilog HDL by Michael D. Cilietti
- 2. Micro programmed Statemachine Design by Michel A. Lynch
- 3. Digital Design of Signal Processing and Communication Systems by Shoab Khan (draft)
- 4. Verilog HDL-A guide to digital design and synthesis

by Samir Palnitkar, Prentice Hall Publisher

- 5. Reuse methodology manual for system-on-a-chip designs by M. Keating and P. Bricaud, Kluwer Academic Publisher, 1998
- 6. UCLA theses on high speed computational unit

EEC 5296 DATABASE DESIGN & MANAGEMENT (3)

Introduction to File Systems and Databases, Relational Database Model, Entity Relationship (E-R) Modeling, SQL, Normalization of Database Tables, Software Engineering Processes, Internet Database Environment, Distributed Database Management Systems, Object- Oriented Databases, Client/Server Systems, The Data Warehouse.

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. Verdeyen

EEC 5246 MICROWAVE ENGINEERING (3)

Microwave components: waveguides, waveguide junctions, directional couplers, isolators, circulators, resonators. Microwave generators: microwave tubes, two cavity klystron, reflex klystron, TWT, magnetron.

Microwave semiconductor devices. Gunn diode, Impact diode, PIN diode, Mixers, Detectors. Microwave measurements, measurement of frequency, VSWR, power, noise and impedance.

Recommended Book

Electronic Communication Systems, 4th edition, by Kenned

EEC 5286 TELECOMM ENGINEERING (3)

Noise in Analogue and digital systems, Packet Switched Networks, Satellite Communication, Mobile communication.

EEC5287 FIBER OPTIC COMMUNICATION SYSTEM (3)

System Design and Analysis, Performance limits,

Component Parts, Advanced Topics in Lightwave Networks.

EEC 5247 THEORY AND DESIGN OF ANTENNAS (3)

Time varying fields, Retarded potentials, Poynting's theorem. Reciprocity. Regions of reactive, transition, and far-field. Ideal dipole. Antenna parameters: Directivity, Gain, and Aperture, Dipole and loop antennas, Driving point impedance, CEM techniques for antennas, Balanced and unbalanced antennas, Antenna polarization, Antenna temperature and noise, Aperture antennas, Feed structures, Antenna arrays.

Recommended Books

- 1. Stutzman, Warren L., and Gary A. Thiele, Antenna theory and design, 2nd edition
- 2. Kraus, John D., and R.J. Marhefka, Antennas 2nd Edition McGraw-Hill
- 3. Balanis, Constantine A., Antenna Theory 2nd Edition Wiley
- 4. Elliott, Robert S., Antenna Theory and Design IEEE press series on electromagnetic wave theory, Wiley-IEEE press

EEC5288 INTEGRATED SERVICES OVER PACKET NETWORKS (NEW GENERATION NETWORKS)(3)

Applications and Transport Protocols, Signaling in Packet Networks, Traffic Control and QoS, Applications

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Recommended Book

Carrier Grade Voice Over IP, by Denniel Collins.

EEC 5289 NETWORK SECURITY (3)

General Introduction (Network Security Overview, Common Security Threats, ARP/IP Address/DNS Spoofing, Anonymity/antianonymity(tracking), Virtual private networking, Network address translation and tunneling), Network Layer Security (Cryptography, Message Confidentiality and Symmetric Encryption, Message Authentication, Authentication and Encryption Protocols, IPSEC, AH, ESP, Public-Key Cryptography, Key management and use, IKE/ISAKMP, Network Management Security (SNMP)), Transport Layer Security (SSL/TLS, SET), Application Layer Security, Authentication Applications (Kerberos, X.509) Electronic Mail Security (PGP. S/MIME). System Security(Intruders and intrusion detection, Malicious Software, (viruses), Firewalls and trusted systems, Operating System Security

Recommended Books

- 1. William Stallings, Cryptography and Network Security, 3rd Edition, Prentice Hall
- 2. Ed Skoudis, Counter Hack A Step by Step Guide to Computer Attacks and Effective Defenses, First Edition 2002, Prentice Hall

3. IPsec: The New Security Standard for the Internet, Intranets, and Virtual Private Networks by Naganand Doraswamy and Dan Harkins, Publisher: Prentice Hall; 1st Edition (July 1999)

EEC 5236 ADVANCED ELECTRONICS (3)

Integrated Circuit Fabrication, Operation Amplifier, Current Sources and Output Stages, case Studies e.g Ap Amp 741, 555 timers.

EEC 5237 POWER ELECTRONICS: CONVERTER MODELLING, 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

Robert W. Erickson and Dragan Maksimovic, Fundamentals of Power Electronics, Second Edition, Kluwer Academic Publishers, 2001, ISBN 0-7923-7270-0.

EEC 5238 ADVANCED POWER ELECTRONICS (3)

Averaged switch modelling of switched-mode converters, input filter design, currentprogrammed control of converters, power and harmonics in non-sinusoidal systems, and linecommutated and pulse-width-modulated rectifiers.

Recommended Book

Robert W. Erickson and Dragan Maksimovic, Fundamentals of Power Electronics, Second Edition, Kluwer Academic Publishers, 2001, ISBN 0-7923-7270-0.

EEC5222 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

- 1. Computer Architecture: A Quantitative Approach, Third Edition By David Petterson and John Hennessy
- 2. Computer Organization and Design: The hardware/software Interface Second Edition By David Petterson and John Hennessy

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

Input Output devices and Communication buses, PCI, DMA

Detailed demonstration of Verilog HDL and simulation of complex digital circuit using

Verilog HDL.

Recommended Book

M. Morris Mano and Charles R. Kime, Logic and Computer Design Fundamentals, Pearson Education Inc.

EEC 5224 VLSI CIRCUIT DESIGN (3)

Overview of VLSI systems(complexity, wires and switches), Fabrication and layout, MOS Transistors, switch and gate logic, CMOS gates, capacitance and switch level simulation, Gate logic: Logic optimization, High level design, hardware description languages, Clocking of VLSI systems, Synthesis, implementation constraints and high level planning, Cell design issues, Pseudo NMOS and pre-charged logic, MOS memory design, MOS decoders (gate sizing, MOS delay models, distributed RC Tree), Data-path functional units(Adders, shifters and multipliers), Testing, design for testability, Input/output issues, Pads, ESD, Power, low power design

EEC 5231 LIGHTWAVE DEVICES (3)

Electro-optics, Acousto-optics, Photo-switching, Fiber optic devices

EEC 5297 DATA STRUCTURES AND ALGORITHMS (3)

Structures and Unions, Arrays, Strings as character arrays, Pointer variables, Memory Management, File Handling, Iteration vs. Recursion, Data Organization Overview, Linked-List, Types of Linked-Lists, Binary Tree,

Balanced Binary Trees, Rapid Sorting Algorithms, Useful Sorting Techniques, Merge Strategies, Introducing Graphs, Working with Graphs.

Recommended Book

Data Structures and Algorithms in C++ by Adam Drozdek

EEC 5215 COMPUTER VISION (3)

Background: Projective geometry (2D, 3D), Parameter estimation, Algorithm evaluation.Single View: Camera model, Calibration, Single View Geometry. Two Views: Epipolar Geometry, 3D reconstruction, Computing F, Computing structure, Plane and homographies. Three Views: Trifocal Tensor, Computing T. More Views: N-Linearities, Multiple view reconstruction, Bundle adjustment, auto-calibration, Dynamic SfM, Cheirality, Duality with Graphs.

EEC 5216 DIGITAL IMAGE PROCESSING (3)

Introduction to Image Processing, Digital Image Fundamentals and Image Acquisition, Image Enhancement in Spatial Domain(Pixel Operations & Histogram Processing, Histogram Equalization, Histogram specification and local enhancement Local enhancement techniques techniques, using Spatial (Mask) Filtering), Image Enhancement in Frequency Domain(Basic Properties of Fourier Transforms, Properties and Implementation (FFT's), Frequency Domain Filtering, Image Sampling, Image Restoration, Noise models and additive noise removal. Adaptive filtering, notch filtering and interactive restoration techniques for additive noise removal Degraded image restoration, Geometric , transformations), Color Imaging, Multi-resolution Processing (including Wavelet Transforms), Image Compression (Introduction. Error-free compression, Predictive coding, Transform coding), Morphological Image Processing (Morphological

Processing on Binary Images, Morphological Processing on Grey Scale Images), Image segmentation(Point, Line and Edge Detection, Edge Linking, and Thresholding), Water Marking and other Advanced Topics

Recommended Books

- 1. Digital Image Processing, R. C. Gonzalez and R. E. woods, 2nd edition, Pearson Education, Inc., 2002.
- 2. Digital Image Processing using MATLAB, R. C. Gonzalez ,R. E. Woods and S.L. Eddins, Pearson Education, Inc., 2004.

EEC 5266 LINEAR SYSTEMS AND CONTROLS (3)

Introduction to state-space and system modeling, state-space representation of dynamic systems, simultaneous linear equations, statetransformations and state-transition matrix, eigen-values and eige-vectors, Cayley-Hamilton theorem, analysis and stability of continuoustime systems, controllability and absorbability for linear systems, controller and observer design, sampled-data systems and discrete-time systems, simultaneous linear difference equations, discrete-time systems, simultaneous linear difference equations, discrete-time transation matrix, discrete-time controller design and implementation. **Recommended Books**

- 1. Linear System Theory by C.T. Chan
- 2. Linear Systems by Rugh.

EEC 5267 DIGITAL CONTROL SYSTEMS (3)

Introduction to discrete time systems. Practical aspects of discrete time systems, Z -Transform and Inverse –Transform, Z -Transform analysis of SISO systems , Digital Signal Processing ,Delta Transform , Discrete Time Fourier Transform and Applications, Introduction to Discrete Time Control , Root Locus , Nyquist Theorem, State Space Analysis and design (Pole Placement , Observers,Optimal Control)

Recommended Book

Discrete-Time Control Systems, 2e, Katsuhiko Ogata, Prentice Hall, 1995.

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 COMMUNI-CATION

Wireless Communication, The Electromagnetic

Spectrum for Wireless Communication, System Types, The Cellular Networks, Aims of Cellular Networks, Power Received by the Mobile Phones in a Cell, Frequency Reuse Concept, Cells Clusters and Shift Parameters, 3-Cells Cluster and its Cochannel Cells in the 1st Tier, 7-Cells Cluster and its Cochannels, 9-Cells, 13-Cells and 16-Cells Clusters and its Cochannels in the 1st Tier. Carrier to Interference Power Ratio, Worse Scenario Omni-Directional Antenna Carrier to Interference Ratio, Cell Sectorisation (3 -Sectors Directional Antennas and 6- Sectors Directional Antennas). Trunking. Traffic. Blocking Probability, Erlang –B Formula, Different Multiple Access Techniques, FDMA/FDD, TDMA/FDD,CDMA, The relative Capacity of Different Systems.

Maxwell's Equations, Constitutive Relations, Wave Equations and Wave Solutions, Time Hormanic Fields, Conservation of Power, Boundary Conditions, Plane Waves, Dielectric and Conductor, Highly Conducting Medium, Slightly Conducting Medium, Quasi Conductor, Reflection and Transmission of Plane Waves,

Brewster's Angle, TM Mode or Vertical Polarization.

Free Space Model, Friis Equations, Fresenel Zones, Diffraction Loss, Line of Sight (Two- Ray)

Electrical Engineering

Model, Flat Earth Model, Okumura –Hata Model, Hata/Cost 23/CCIR/Model, The Lee Model

Recommended Books

- 1. Antennas and Propagation for Wireless communications By Simon R. Saunders
- 2. Wireless Communication By Rappaport

EEC 5266 SPECIAL STUDIES (3)

EEC 5299 MASTER'S THESIS (6)

EEC 6299 Ph.D. THESIS (1-9)

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.

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CHAIRMAN Prof. Dr. Sahar Noor Ph.D. (UK) PROFESSORS Prof. Dr. Iftikhar Hussain Ph.D. (UK) ASSOCIATE PROFESSOR Dr. Shahid Maqsood Ph.D. (UK) ASSISTANT PROFESSOR Engr. Rashid Nawaz M.Sc. (USA) Dr. Misbah Ullah Ph.D. (S.Korea) Dr. Tufail Habib Ph.D (Denmark) Engr. Fawad Haidar M.Sc. (UK) LECTURERS Dr. Rehman Akhtar Ph.D. (USA) Engr. Aamir Sikandar M.Sc. (UK) Engr. Sikandar Bilal Khattak M.Sc. (Pak) Engr. Altaf Hussain M.Sc. (Pak) Engr. Khawar Naeem M.Sc. (Pak) 162-AS BS



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 programme in the Manufacturing Systems Engineering Stream and Ph.D.

Core area of specialization

1		IE 5710 Manufacturing Plannin	Manufacturing Planning and Control		
2		IE 5722 Engineering Experimer	Engineering Experimental Design		
3		IE 5726 Engineering Optimizat	Engineering Optimization		
4		IE 5730 Maintenance & Safety I	Maintenance & Safety Engineering		
5		IE 5734 Quality Engineering	Quality Engineering		
6		IE 5738 Computer Modelling a	Computer Modelling and Simulations		
7		IE 5750 Facility Analysis and De	Facility Analysis and Design		
8		IE 5754 Design and Analysis of I	Design and Analysis of Manufacturing Systems		
9		IE 5758 Advanced Manufacturi	ing Processes		
1	0.	IE 5770 Mathematics			
1	1.	IE 5772 Technical Report V Methodology	Writing and Research		

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
23.	IE 5725	Supply Chain Management
24.	IE 5727	Business Process Re-engineering

25. IE 5728 Management Information System

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- 26. IE 5729 Combinatorial Optimization
- 27. IE 5731 Quality Assurance
- 28. IE 5732 Statistical Quality Control
- 29. IE 5733 Project Management
- 30. IE 5735 Stochastic Optimization
- 31. IE 5737 Six Sigma Methodologies
- 32. IE 5739 Cost & Management Accounting
- 33. IE 5740 Total Quality Management
- 34. IE 5741 Project Evaluation & Feasibility Analysis
- 35. IE 5742 CAD/CAM
- 36. IE 5743 Business Forecasting
- 37. IE 5744 Operations Management
- 38. IE 5745 Environmental Management & Safety
- 39. IE 5747 Marketing Management
- 40. IE 5762 Computer Integrated Manufacturing
- 41. IE 5766 Artificial Intelligence with applications
- 42. IE 5780 Computer Applications
- 43. IE 5784 Deterministic Optimization
- 44. IE 5788 Stochastic Optimization
- 45. IE 5790 Special Topic

IE 5799 Master's Thesis

IE 6799 PhD Thesis

LIST OF APPROVED COURSES

IE 5701 Engineering Economics 3 (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 (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 (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

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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)

Matrix forces method, Matrix stiffness method, variational formulation and approximation (Boundary and initial-Value problems, gradient and divergence theorems), Ritz methods, method of weighted residuals, time-dependent problems. Finite Element Error Analysis (Approximation Errors, Various measures of errors, Convergence of solutions and accuracy of solutions), Numerical integration & computer implementation, Coordinate transformation (Integration on a Master Element, Modeling, Mesh Generation), Load Representation, use of finite element software.

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)

Introduction: Sequential decision processes, DP functional equations, problem formulation and solution, State transition graph models, state-space generation, complexity, greedy algorithms, probabilistic dynamic programming. Applications of DP: Optimal allotment, allpairs shortest path problems, assembly-line balancing, optimal binary search tree problem, optimal covering problem, discounted profits problem, flowshop problem, Integer linear programming.

Integer knapsack problem, mini max problem, optimal distribution and optimal permutation problems, optimal selection problem, Process scheduling problem, Transportation problem, Traveling salesman problem. Modelling of DP problems. Introduction to DPS.

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 management

IE 5709 Human Resource Management 3 (3,0)

Role and Organization of Personnel Function, Behaviour Aspects, Human Resources Planning, Recruitment, Job Analysis and Design, Managing Performance. Training and Development, Pays and Benefits, Industrial Relations.

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, twoperson 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 matricesnumber of steps, speed and accuracy issues, the LP decomposition of matrices, the revised Simplex method, General LP problems and their solution by Simplex

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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)

Tool design objectives and nomenclature, Tool Materials, Work holding principles, Jig Design, Fixture Design, Tool Design for Inspection and Gauging, Forming and Drawing Tools, Tool Design for Joining Processes, Computers in Tool Design.

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, Nonparametric 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.

Monitoring: Remote monitoring and out-station operation, degree days performance lines and targeting,

Audits, Environmental, energy and social.

Energy Modelling and Forecasting, reserves and relation of resources to future options. Energy demand models, Energy Transmission & Utilization, Waste Heat Recovery System, Energy Resources, Solar Energy Conversion Systems.

IE 5724 Organizational Behaviour 3 (3,0)

Management functions and roles. Need for systematic study of human behaviour. Challenges and opportunities for O.B., Responses to Global and Cultural Diversity. Foundations of Individual Behaviour, Perception and Industrial Decision Making. Values, Attitudes and Job Satisfaction, Motivation Concepts, Group Behaviour & Work Teams, Organization System.

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)

Introduction of MIS, Meaning & Role, organization structures, Business Process, Systems Approach. Programmed & Non- Programmed, Strategic & Project Planning for MIS, Models of Decision Making different types of IS: MIS, DSS, ESS. MIS and the information Concepts, System Concepts, Handling system complexity MIS and system concepts, need for system analysis, SSAD, MIS and System Analysis. Development of MIS, Ascertaining the Class of information, Management of quality in MIS, MIS: the factors of success and failure. EMS and MIS, MIS Service industry, choice of IT in MIS.

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.

IE5731 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.

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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-ofstatistical 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 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 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 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 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 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 liabilities and contingencies, Marketable securities, intangibles, Cost concepts, Indirect allocation of cost.

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)

Project Planning & Appraisal, Managing Project with Project Management Tools, Project Management Control, Indicators and Measurement of Monitoring and Evaluation, General Management Skills, Financial aspects of new project, Feasibility analysis of a model project, Sensitivity analysis.

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, eduction of carbon footprint.

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.

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;

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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.

IE5766 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 2 (2,0)

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.

IE 5784 Deterministic Optimization 3 (3,0)

Selection of an OR tool for a particular production/ operations management application, Formulating deterministic optimization models, Defining objectives,

Industrial Engineering

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.

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 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.

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CHAIRMAN

Prof. Dr. M. Naeem Khan

PF	RO	FE	SS	0	RS

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	
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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. Umar Ibrahim	Ph.D. (USA)
Dr. Feroz Shah	Ph.D. (Pak)
Engr. Ihsan Ullah	M.Sc. (Pak)
Dr. Muhammad Alamzeb Khan	Ph.D. (UK)
Dr. Muhammad Sadiq Khattak	Ph.D. (USA)

Lecturers

Engr. Tabassum Yasmin	M.Sc (Pak)
Engr. Naveed Ahmad	M.Sc (USA)
Engr. Zuhaib Ali Khan	M.Sc (Pak)
Engr. Adeel Ahmad	M.Sc (Pak)
Engr. Zeeshan Zahir	M.Sc (Pak)

Lab Engineer

Engr. M. Usman Khan

M.Sc (Pak)

Ph.D. (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 **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 Advance Control Engineering ME 5371 Modeling and Simulation **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

ME5301 THEORY OF ELASTICITY (3)

Formulation of Problem in Elasticity. Stress and Displacement Formulations for Plane Stress and Plane Strain Problems. Displacement Formulation for 3-D Problems. Biharmonic Equations. Airy Stress Function. Plain Stress and Plain Strain Problems in Cartesian and Polar Coordinates. Axisymmetric Plane Problems. Semi-inverse Method, Thermoelasticity. Contact Problems. Energy Methods in Elasticity, General Solution of Torsion Problem. Stress and Displacement Formulation for Torsion Problem. Torsion of Simply and Multiply Connected Prismatic Bodies. Solution Derived from Equations of Boundaries. Approximate Solution for Torsion of Cellular Sections.

Recommended Books

1. Theory of Elasticity by S.P. Timoshenko and Goodier, McGraw Hill

- 2. Elasticity, Tensor and Dyadic Approach by Pe-Chi-Chou, John Wiley
- 3. Advance Mechanics of Material by Hugh Ford, McGraw Hill
- 4. Elasticity by J.R. Barber, Kuwler Academic Press

ME 5303 FINITE ELEMENT ANALYSIS (3)

Review of Relevant Mathematics, Matrix, Algebra. Variation Calculus, Direct Formulation of Finite Element Method, Analysis. Variational and Weighed Residual Formulations. Principle of Minimum Potential Energy. Principle of Virtual Displacement. Parameter Functions for 1-D, 2-D and 3-D Elements. Two-Dimensional and Axi-Symmetric Stress Analysis. Modeling of Industrial Problems. Truss, Beam, Plate. Use of Commercial FEA Package.

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.

Strain Gages: Different types of strain gages. Properties of strain gage-system. Electrical resistance strain gages. Strain sensitivity. Gage constructions. Gage sensitivity and gage factor. Power dissipation by a gage. Selection of a gage. Strain gage circuits.
Potentiometer and Wheatstone bridge. Commercial strain indicators. Effects of lead wires. Swatch etc. Load cell and transducers. Strain-analysis methods. Two, Three and Four Element Rosettes.

Photoelasticity: Optical description of light. Design of optical elements. Wave plates. Stress optic law. Place and circular polariscope. Identification/ Analysis of Isochromatic and Isoclinic fringes. Compensation techniques. Separation methods. Scaling model to prototype stresses. Stress freezing techniques for 3-dimensional photoelasticity.

Brittle Coatings: Brittle coating Stress. Stress and Strain relation for coating, strain sensitivity of coating. Law of failure of brittle coating, primary and secondary cracks failure chart for coating.

Recommended Books

- 1. Experimental Stress Analysis by J.W. Dally and W.F. Riley
- 2. Handbook on Experimental Mechanics. Edited by Albert S. Kobayashi

ME 5306 FATIGUE OF METALS AND STRUCTURES (3)

Nature of fatigue failure. Crack nucleation and crack propagation in fatigue loading. Fatigue testing machines. High cycle fatigue S-N-P curves. Factors affecting S-N-P Curves. Influence of non-zero mean stresses. Multi-axial fatigue stresses. Fatigue failure theories. Cumulative fatigue damage and life prediction. Low cycle fatigue. Fatigue stress concentration factor for elastic and plastic ranges. Cyclic stress-strain curve, cycle counting methods, and cumulative damage in low cycle fatigue. 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

- 1. Analysis and performance of fiber composites by B.D. Agarwal and L.J. Broutenan, John Willey.
- 2. Mechanics of composite Materials by Robert M. Jones.
- 3. Principles of Composite Material Mechanics by Ronald F. Gibson

4. Composite Materials Engg. And Science by F. L. Mathhews and Rawlings.

ME 5309 FRACTURE MECHANICS (3)

Review of Stress and Strain, Elasticity and Plasticity. Yield Criteria, Necking. Yielding Microstructure Effect. Fracture Appearances and Features, Elements of Fracture Mechanics. Brittle Fracture, Griffith's Theory, Nucleation vs. Propagation, Stress concentration, Elastic and Plastic Solution, Fracture Toughness, Testing Technique, Plane Stress vs. Plane Strain Fracture, Procedures and Techniques for Evaluating Klc (Plane Strain Fracture Toughness) Micro-Structural Aspects of Brittle Fracture. Ductile Fracture and Micro-Void Coalescence, Inter-Granular Fracture. Yielding Fracture Mechanics, R-Curve J Integral. Critical COD, Failure Analysis, Case Studies.

Recommended Book

Fracture Mechanics by T.L. Anderson, CRC Press

ME 5310 BEHAVIOR OF MATERIALS UNDER IMPACT LOADING (3)

Stress Waves: Propagation of Elastic Waves in Continuum. Wave Reflection and Interaclion. Solution of Wave Equation by Method of Characteristics. Experimental Techniques, Diagnostic Tools: Laser Interferometry, Rotating Cameras. Experimental Techniques for Impact Loading: Hopkinson Bar, Kolsky Bar, Fracture Bar, Gas Gun. Material Behavior Under High Strain Rates: Steels, Aluminum Alloys, MMCs, Plastics. Dynamic Fracture: Fracture Mechanics, Limiting Crack Speed. Crack Branching. Stress Wave Loading of Cracks. Spalling. Fragmentation. Dynamic Fracture of Steels, Aluminum Alloys, Plastics. Applications: Introduction, Shaped Charges and Projectiles. Penetration. Armor. Dynamic Effects in Geological Materials.

Dynamic Events in Space.

Recommended Book

Dynamic Behavior Of Materials By M. A. Meyers, McGraw Hill.

ME 5312 ADVANCED STRESS ANALYSIS (3)

State of Stress at a Point, Stress Vector, Normal and Shear Stress Components, Stress Transformation, Principal Stress and Principal Planes, Mohr circle for Three Dimensional State of Stress, Stress Equilibrium.

Deformation and Strain, Component of Strain, Strain Transformation, Principal Strain, Plane Stress and Plane Stress, Strain Displacement Relation.

Generalized Hook's Law three dimensional, Stress Strain relation for Isotropic and homogenous material, elastic constants.

Failure Criteria of Material, Yielding, Fracture and Fatigue, Theories of Failure, Maximum Principal Stress theory, Tresca theory, Maximum Distortion Energy theory, application of failure theories. Plane Elasticity, Governing equation for plane stress and strain problems, Airy stress function. Bending of cured beams and rings. Energy method deflection. Thick wall cylinder and sphere. Torsion of circular and non circular sections, Torsion of thin multi-cell sections. Stress concentration and its application in actual structures.

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 DeformationI Eulerian and Lagrangian formulation, Geometric measure of Strain, Relative deformation Gradient. Rotation and Stretch Tensors, Compatibility Condition, Determination of Displacements.

General Principles: Integral Transformation, Conservation of mass, Energy continuity, momentum and equation of motion, Principal of Virtual Displacements, Entropy and second Law of Thermodynamics and Clausius Inequality,

Constitutive Equations: Ideal Materials, Generalize Hooks Law, Anisotropy and Isotropy, Strain energy function, Elastic Symmetry, Plastic Symmetry, Plastic Behavior of Metals, work hardening, Levy¬ Mises Perfectly Plastic, Prandtl-Reuss Elastic, Perfectly Plastic and Visco-plastic Materials.

Applications to Linearized Theory of Elasticity.

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)

Introduction to Stress and Strain analysis. True stress and True strain. Yield Criteria for ductile metals. Stress-Strain Relations for elastic and plastic ranges. Strain Hardening Hypothesis. Behavior after Necking, Plastic instability. Strain Rates and Temperature, Ideal work for Plastic Deformation, Slab Analysis, Upper Bound Analysis, Plane Strain Frictionless Extrusion. Plane Strain Indentation. Slip-Line Field theory and its application. Cupping, drawing, redrawing.

Recommended Books

- 1. Metal Forming Mechanics and Metallurgy by William F. Hosford and Robert M. Caddell
- 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).

One Dimensional flow, Normal Shock relations. Flow with Heat Transfer, Flow with Friction.

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.

Unsteady Wave motion, Moving Normal Shock Waves, Incident and Reflected Expansion Waves, Finite Compression Waves.

Recommended Book

Modern Compressible Flow: With Historical Perspective by John D. Anderson, McGraw Hill, 3rd Edition.

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

- 1. Computational Fluid Dynamics—The Basis with Applications by John D. Anderson, McGraw-Hill, 1995.
- An Introduction to Computational Fluid Dynamics: The Finite Volume Method by H. Versteeg and W.Malalasekra, Pearson Education, 2nd Edition
- Computational Techniques for Fluid Dynamics by C.A.J. Flectcher, Vols I and II, Springer Verlag, Berlin, 1988.

ME 5331 DYNAMICS OF MECHANISMS (3)

Prerequisite: ME 5335 Design of Mechanisms. Review of basic concepts in dynamics of rigid bodies. Kinetostatic analysis of mechanisms: Graphical method, Analytical method. Matrix method. Time response analysis of mechanisms. Analytical methods in dynamics: Virtual work. Lagrange's equations. Use of commercial software, e.g. M.SC Adams, to solve practical problems of mechanism dynamics.

Recommended Books

- 1. Mechanism Design: Analysis and Synthesis, Vols. I and II, A Erdman and G Sandor, Prentice Hall.
- 2. Theory of Machines and Mechanisms, J Shigley and J Uicker, McGraw Hill.
- 3. Principles of Dynamics, D Greenwood, Prentice Hall.

ME 5332 ADVANCED MECHANICAL VIBRATION (3)

Review of single degree-of-freedom systems. Frequency response. Response to general periodic excitation. Impulse and step response. Convolution integral and Fourier Integral. Multi-DOF systems: Principal coordinates. Influence coefficients. Lagrange's equation. Determining natural frequencies and mode shapes: Dunkerley's formula, Rayleigh's method, Holzer method, matrix iteration method, Jacobi's method. Continuous systems: Transverse vibration of string or cable. Longitudinal, torsional, and lateral vibration of bars and beams. Vibration of membranes. Nonlinear vibrations: Nonlinear stiffness, Duffing equation, perturbation method, nonlinear damping, Van der Pol equation.

Recommended Books

- 1. Mechanical Vibrations, S. S. Rao, Prentice Hall, 4th edition.
- 2. Theory of Vibration with Applications, W T Thomson and M D Dahleh, Prentice Hall, 5th edition.
- 3. Fundamentals of Mechanical Vibrations, S G Kelly, McGraw Hill, 2nd edition.
- 4. Engineering Vibration, D J Inman, Prentice Hall, 2nd edition.

ME 5333 VIBRATION MEASUREMENT AND ANALYSIS (3)

Introduction Characterization of Vibration. Vibration Measuring Instruments. Measurement of Overall Vibration levels. Frequency Analysis. Predictive Maintenance Systems. Special Vibration Measuring Techniques. Vibration Control Measures. Recommended Books

- 1. Nakra and Chaudhry, Instrumentation, Measurement and Analysis, Tata McGraw Hill Publishing Company.
- 2. Nakra, Yadava, Thuestad, Vibration Measurement and Analysis, National Productivity Council, New Delhi, India.
- 3. R.H. Wallace, Understanding and Measuring Vibrations, Springer, New York.
- I.T. Brock Mechanical Vibration and Shock Measurement, Bruel and Kjaer, Naerum, The Netherlands.

ME 5334 MODAL ANALYSIS (3)

Introduction, Application and Philosophy of Modal Testing, Summary of Theory, Measurement Methods, Analysis and Test Procedures. Introduction to Mobility Measurement Techniques. Basic Measurement System Structure Preparation, Excitation of Structure, Transducer and Amplifiers, Analyzers, Digital Signal Processing, Use of Different Excitation Types, Calibration, Mass Cancellation, Rotational Mobility Measurement, Measurements on Non-linear Structure, Multi Excitation Methods. Introduction to Modal Parameters Extraction Methods, Preliminary Checks of PRF Data, SDOF Modal Analysis, I Peak Amplitude, SDOF Modal Analysis-II, CircleFit Method, SDOF Modal Analysis-II Inverse Method, Residual, MDOF Curve-Fitting Procedures, MDOF Curve -Fitting in the Same Domain, Global or Multi Curve-Fitting, Nonlinear Systems. Introduction to Derivation Mathematical

Models, Modal Models, Display of Modal Model, Response Models, Spatial Models, Mobility Skeletons and System Models. Applications, Comparison of Experiment and Prediction, Correction Of Adjustment of Models, Structure Modifications; Coupled Structure Analysis, Response Prediction Modifications, Coupled Structure Analysis, Response Prediction and Force Determination.

Recommended Books

- 1. Modal Analysis By D.J. Ewins, Wiley.
- 2. Modal Testing, Theory And Practice By D.J. Ewins, Wiley.

ME 5335 DESIGN OF MECHANISMS (3)

Introduction to kinematics and mechanisms: The four-bar and six-bar linkages. Degrees of freedom. Computer-Aided-Design of mechanisms. Displacement and velocity analysis of mechanisms: Graphical and analytical methods. Relative velocity and instant center methods. Mechanical advantage. Acceleration analysis of mechanisms. Kinematic synthesis of mechanisms: Tasks and types of synthesis. Graphical synthesis. Analytical synthesis. Students will write computer programmes to implement the methods studied.

Recommended Books

- 1. Mechanism Design: Analysis and Synthesis, Vol. I, A Erdman and G Sandor, Prentice Hall.
- 2. Theory of Machines and Mechanisms, J Shigley and J Uicker, McGraw Hill.

Mechanical Engineering

ME 5336 INDUSTRIAL ROBOTICS (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

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.

Simulation of First and Second Order System: Impulse, Step and Ramp response. Frequency response. Electrical, Mechanical, Thermal, Fluid and Mixed systems. Analysis of filters. **Recommended Books**

- 1. System Dynamics: modeling, analysis, simulation, design, E O Doeblin, Marcel Dekker
- 2. Analysis and Design of Dynamic Systems, I Cochin and W Cadwallender, Addison-Wesley.

ME 5339 ADVANCED CONTROL ENGINEERING (3)

Prerequisite: ME5338 Modeling of Dynamic Systems

Review of the basic concepts: Open and Closed loop control system, Block diagram algebra, stability, and Root Locus analysis. Control System Design by the Root-Locus Method: Lag-Lead Compensation, Parallel Compensation.

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 feed back, Ackermann's formula, internal model design.

Note: Matlab and Simulink will be used throughout the course.

Recommended Books

- 1. Modern Control System by Richard C. Dorf and Robert H. Bishop 7th edition.
- 2. Modern Control Engineering by Katsuhiko Ogata 4th edition

ME 5341 ADVANCED HEAT TRANSFER (3)

Review and Engineering applications of Heat Transfer.

Two Dimensional Steady State Conduction, Separation of Variable Method, Graphical Method and Numerical method, Finite Difference Equations, Finite Difference Solutions, Matrix Inverse Method.

Transient Heat Conduction, Lumped Capacity Method, Transient Heat Transfer in Large Plane Wall, Long Cylinder, Spheres, and Semi Infinite Solids.

Convection Heat Transfer, Convection, Velocity and Thermal Boundary Layers, Heat and Momentum Transfer in Turbulent Flows, Significance of Dimensionless Parameters, Differential Convection Equations, Integral Solution of Boundary Layer Equation for Flat Plate, Relation between Fluid Friction and Heat Transfer, Turbulent Boundary Heat Transfer.

Forced Convection over Cylinders, Spheres and Tube Banks, Free Convection over Plates and Cylinders.

Recommended Books

- 1. Heat Transfer Textbook by John H. Lienhard
- 2. Heat and Mass Transfer by Frank P. Incropera

ME 5342 ENERGY ENGINEERING (3)

Codes & Standards, Energy Accounting and Economics, Energy Audits and Instrumentation, Electrical System Optimization, Peak Shaving, Thermodynamics of Waste Heat recovery, Design of Heat Exchangers, Utility Systems Optimization Energy Usage in HVACs.

Use of Commercial Software for energy benchmarking.

Recommended Books

- 1. Handbook of Energy Engineering by Albert Thumman and D. Paul Mehta, CRC Press, 2008.
- 2. Handbook of Energy Audits by Albert Thumman and William Younger, CRC Press, 2008.

ME 5351 CHARACTERIZATION OF MATERIALS (3)

Optical microscopy and quantitative metallography. Advanced Microscopy Techniques: AFM, SEM, EDS, TEM and STEM, Non-destructive evaluation: radiography, eddy current, ultrasonic techniques, optical microscopes, magnetic flux and fluorescence methods. Introduction to spectroscopy: FTIR, Emission Spectroscopy and others, Thermal Characterization, DTA, DSC and DMA, Crystallographic and X-ray diffraction.

Recommended Books:

- 1. Douglas B.Murphy Fundamental of Light Microscopy and Electronics Imaging Kindle Edition 2001.
- B.D.Cullity Elements of X-ray Diffraction, Addision Wesely Reading Mass 1978

 Robert Cahn Concise Encyclopedia of Materials Characterization, Second Edition: 2nd Edition (Advances in materials Science and Engineering) Elsevier Publication 2005.

ME 5352 MATERIALS THERMODYNAMICS

Concepts of Helmholtz Free Energy and Gibbs Free Energy, Energy-Property relationships, Thermal Equilibria, Chemical Equilibria, Ellingham Diagrams, 1st order and 2nd order Transformations, Gibbs Helmholtz Relationships, Fugacity and Chemical activity, Equilibrium constant and its variation with temperature, Vant Hoff's equation, Effect of temperature and pressure on phase transformations, Clapeyron equation, Thermodynamics of solutions.

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)

ME5353 COMPOSITE MATERIALS

Composites: Basic principles, applications and properties. Processing of reinforcements: Particulates, whiskers and continuous fibers.Methods of production for PMCs, MMCs and CMCs. Mechanical behavior of composite materials. Fracture mechanics. Nanocomposites. Recommended Books:

- 1. Composite Materials: Engineering and Science by Matthew and Rawlings.
- 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.
- 2. Mechanical Properties of Solid Polymers by I. M. Ward.

- 3. Introduction to Polymers by R. J. Young and P. A. Lovell
- 4. Principles of Polymer Engineering by N. G. McCrum, C. P. Buckley and C. B. Bucknall

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
- 2. Joon B. Park, Biomaterials: Principles and Applications, 2002.

ME 5357 EVALUATION TECHNIQUES & INSTRUMENTATION

Introduction to materials evaluation techniques; their role in quality assurance and production environments.Classification of materials evaluation techniques. Destructive testing - hardness, tensile, compression, impact, fatigue and creep. Neutron Diffraction, X-Ray absorption, X-Ray Fluorescence spectroscopy, Electron Diffraction- diffraction pattern in specific modes, LEED and RHEED, Electron Optics, Electron Microscopy-Transmission and Scanning Electron Microscopy, STM and AFM, Compositional analysis employing AES, ESCA and Electron Probe Microanalysis.

Recommended Books:

- 1. David D. Brandon and Wayne D. Kaplan Microstructural Characterization of Materials
- Dawn Bonnel, Scanning Probe Microscopy and Spectroscopy: Theory, Techniques, and Applications 2000.
- 3. D.J. O'Connor Surface Analysis Methods in Materials Science, Springer 2008.
- Adam J. Schwartz, Mukul Kumar, Brent L. Adams, and David P. Field Electron Backscatter Diffraction in Materials Science by 2009
- Robert Cahn Concise Encyclopedia of Materials Characterization, Second Edition: 2nd Edition (Advances in Materials Science and Engineering) Elsevier Publication 2005.
- Ray F. Egerton Physical Principles of Electron Microscopy: An Introduction to TEM, SEM, and AEM Springer, 2008.

ME 5361 NUMERICAL METHODS FOR ENGINEERS (3)

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. Recommended Books

- 1. Numerical Methods for Engineers By Steven C. Chapra & Raymond P. Canale.
- 2. Numerical Mathematics and Computing By Ward Cheney & David Kincaid.

ME 5362 COMPUTER APPLICATIONS IN MECHANICAL ENGINEERING (3)

3D Modeling, Assembly and Drawing, Using Pro-E. Use of 3D Models in Conceptual Design & Iterations. Project Based Assignments. Modeling Physical Phenomenon and Mathematical Equations Using MATLAB. Matrix Analysis, Numerical Visualization. Building of Graphical User Interface. Data Analysis.

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)

Modeling. Mathematical Model. Nature of Design Process. Analysis and Design Models. Optimal Design. Formal Optimization Model. Boundedness, Feasibility and Constraint Activity. Topography of the Design Space. Mathematical Review. Notation. Multi-Variable Functions. Continuity' Gradient and Directional Derivatives. Hussein Taylor's Series. Quadratic Forms and Definite Matrices. Convergence of Algorithms. Conditions of Optimality: Necessary and Sufficient Conditions for Unconstrained and Constrained Optima. Meaning of Lagrange Multipliers. Methods of Unconstrained Optima. One Dimensional Minimization. Bisection And Golden Section Initial Bracketing, Polynomial Interpolation. Multi-Dimensional Minimization. Steepest Descent. Conjugate Direction & Conjugate Gradient Methods. Newton's Method and its Modifications. Quasi-Newton Methods. Scaling. Stopping Criteria. Methods For Constrained Optima. Interior and Exterior Penalty Methods. Augmented Lagrangian Method. Direct Methods

Recommended Books

- 1. Principles of Optimal Design by Papalambros & Wilde, McGraw Hill.
- 2. Introduction To Optimum Design by J. Arora, McGraw Hill.

ME5364 CONDITION MONITORING OF ROTATING MACHINERY (3)

Introduction to Basic Concepts of Machine Condition Monitoring, Condition Based Maintenance Techniques in Industry, Predictive Analysis, Diagnostic Analysis, Major Benefits of a Condition Monitoring Programme. Practical Machine Condition Monitoring Systems in Industry, Vibration Monitoring Wear Debris Monitoring, Temperature Monitoring, Noise Monitoring, Noise Monitoring, Performance Monitoring, Data

Accusation Methods, Data Analysis Techniques, Data Interpretations and Diagl liStics, Instrumentation Required. Computer Aided Machine Condition Monitoring, Use of Rotor Dynamic Simulation as an Aid to Fault Diagnostics. Intelligent Knowledge Based Experts systems for Coutinuous Machine Surveillance in Advanced Condition Monitoring. Selection and Installation of a Machine Condition Monitoring System, Analysis of the Problem Measurable Parameters, System Requirements, Economic Considerations in the Selection and Installation of a Machine Condition Monitoring System, Case Studies.

Recommended Books

- 1. Machiuery Health Monitoring by Bruel and Kjaer Hand Book, Naerum, Denmark.
- 2. Condition Monitoring by J.S. Rao, Narosa Publishing House, New Delhi.
- 3. Handbook of Condition Monitoring by Alan Davis, Chapman and Hall.

ME 5365 PHASE EQUILIBRIA AND MICROSTRUCTURE (3)

Review of Fe-Fe3C Phase Diagram and Heat Treatment Processes. Isothermal Transformation (IT). Continuous Cooling Transformation diagram (CCT). Effect of Alloying elements on the IT and CCT Diagrams. Nucleation and Growth Mechanism of Pearlite, Nucleation of Austenite, Bainite, Ferrite and Martensite Grains. Grain Boundary Carbides, Growth of dislocation, Principles of Dispensaries Strengthening, Phase Diagrams ContainingThree-

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Phase Reactions. Eutectic and Hyper Eutectic and Hyper Eutectic Alloys. Strength of Eutectic Alloys. Ternary Phase diagrams, Isothermal Plot, Isopleth Plot. Effect of Microstructure in Controlling the Mechanical Properties of Engineering Materials. Case Studies of Various Strengthening including Grain Boundaries, Carbide Thickness and Solid Solution Strengthening.

Recommended Books

- 1. Mechanical Metallurgy by George E. Dieter, McGraw Hill
- 2. The Science and Engineering of Materials by Donald R. Askland
- 3. Principles of Materials and Engineering by William F. Smith.

ME 5366 FINANCIAL ANALYSIS (3)

Financial Statement Analysis, Funds Analysis, Cash Flow Analysis, Cash Budget, Working Capital Management, Cash & Marketable Securities Management, Accounts Receivable and Inventory Management, Short Term Financing, Capital Budgeting and Estimating Cash Flows, Capital Budgeting Techniques, Risk and Managerial Option in Capital Budgeting, Required Return and Cost of Capital, Operating and Financial Leverage, Capital Structure Determination, Dividend Policy, Intermediate and Long Term Financing.

Recommended Books

Fundamentals of Financial Management by

James C, Van Home and John M.Wachowiez, JR" Prentice Hall.

ME 5367 HUMAN RESOURCE MANAGEMENT (3)

Human Resources in a Globally Competitive Business Environment, Human Resource Management (A Field Of Transition), Diversity at Work, Job Analysis and Human Resource Planning, Recruiting, Staffing, Orienting and Training, Appraising Employee Performance, Managing Careers, Pay System, Indirect Compensation: Employee Benefit Plans, Motivational Strategies for Improving Performance and Productivity, Union Representation and Collective Bargaining.

Recommended Books

- 1. Managing Human Resources by Wayre F. Cascio: McGraw Hill Book Company.
- 2. Human Resource Management by David A Decendzo Stephen P. Robbins, Oxford Press.

ME 5368 TOTAL QUALITY MANAGEMENT (3)

ISO-9000 Quality Models, Quality in Manufacturing and Service, Principles of Total Quality Management, Leadership and Strategic Planning, A Focus on the Custo!ller, Quality Measurement, Methods for Continuous Improvement, Participation and Teamwork, Implementation Issue and Strategies.

Recommended Books

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

Mechanical Engineering

2. Total Quality Management by Johns Ornland Amriu S. Soha, Pacific Rim.

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

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

- 2. Digital Controls of Dynamic Systems by G F Franklin, J D Powell, and M Workman, 3rd edition
- Computer Controlled Systems -- Theory and Design by Karl J.Astron, BjornWhittenmark 3rd edition

ME 5370 INDUSTRIAL AUTOMATION (3)

Automation: Automated Flow Lines, Basic configuration, Methods of work part transport, Analysis of Automated Flow lines, Analysis of transfer lines without storage, Buffer Storage, Automated flow lines with buffers storage. Programmable Logic Controllers: Introduction to PLCs, Advantages of PLCs, Ladder Logic Diagrams, PLC Hardware/Components of PLC, PLC Operating Cycle, Additional capabilities of a PLC, Programming the PLC, Latches, Design Cases (Deadman Switches, Conveyor, Accept/Reject Sorting), Addressing. CNC Machines: Review of Basic concepts (Fundamentals of CNC, Knowledge about machine, Motion type, Compensation type, Programme formatting), floating zero point system, Absolute and Incremental System, Classification of CNC system, Application of Numerical Control, Direct Numerical/Distributed Numerical Control. CNC Programming, Computer assisted part programming, Automatically programmed tools (APT Programming System), CAD/CAM approach to part programming, CAD/CAM application (turning problem, surface milling, machining of curved surfaces).

Recommended Books

- 1. Automation, Production System and Computer Integrated Manufacturing by Mikell P.Groover, Prentice Hall.
- 2. CADCAM 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

Introduction to Matlab: The Matlab environment. Vectors, matrices arrays in Matlab. Linear Algebra in Matlab: Matrix operations. Linear Systems of equations. Inverses and Determinants, Cholesky, LU and QR factorizaitons. Eigenvalues. singular value decomposition. polynomials and interpolation.

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

Differential Equations: Numerical differentiation and integration. Initial value problems, boundary value problems, partial differential equations. Symbolic mathematics in Matlab. Building Graphical User Interface in Matlab. Introduction to Simulink.

Recommended Books

- 1. Introduction to Matlab for Engineers, by W J Palm III.
- 2. Advance Engineering Mathematics, by Wyle. McGraw Hill

ME 5372 RANDOM VIBRATION (3)

Prerequisite: ME5332 Advanced Mechanical Vibration

Characteristics of random vibrations. Use of probability distribution and spectral densities for he description of random vibration. Random vibration in mechanical systems. Analyses of random data. Stochastic response of linear and nonlinear systems. Failure due to random vibrations.

Recommended Books

- An Introduction to Random Vibration in Mechanical Systems, J D Robson, Academic Press 1963, Elsevier 1963/1970.
- 2. Random Vibration, S H Crandall (ed), MIT Press, 2 volumes.
- 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)

Introduction to Organizational Behavior, Values, Attitudes, Job Satisfaction, Personality and Emotion, Perception and Individual Decision Making. Basic Motivation Concepts/theories, Motivation: From Concepts to Applications, Foundations of Group Behavior, Understanding Work Teams, Communication, Basic Approaches to Leadership, Contemporary Issues in Leadership, Power and Politics, Conflict and Negotiation, Organizational Culture, Stress in Organizations and its Management.

Recommended Books

- 1. Organizational Behavior, 8th Ed. By Stephen P. Robbins (Prentice Hall).
- 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)

Introduction to decision analysis, Why are Decisions Hard? Where is Decision Analysis used?, Elements of Decision Problems, Values and Objectives, Structuring Decisions Structuring Values, Influence Diagrams Decision Trees and Expected Monetary Value Solving Influence Diagrams: Overview, Solving Influence Diagrams Creativity and Decision Making, What is Creativity?, Theories of Creativity Sensitivity Analysis, Probability Basics, Probability Theory, Venn Diagrams, Uncertain Quantities, Discrete Probability Distributions, Expected Value, Variance and Standard Deviation Monte Carlo Simulation, Utility Function use.

Recommended Books

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

ME 5375 PRODUCT DESIGN AND DEVELOPMENT (3)

The design process, Total Design. Market/User Needs, Product Design Specification. Conceptual Design & evaluation. Design for Manufacture & Design for Assembly. Electronic Aids & Standards for computer aided design. The Total approach to product development. Design Matrix. Concept Generation & Concept Selection. Industrial Design. Effective Prototyping. Economics of Product Development. Managing Product Development.

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.
- 2. Product Design & Development by Ulrich & Eppinger.
- 3. Total Design by Pugh.

ME 5383 ADVANCED CAD/CAM (3)

Graphics Hardware/Software Structure/Selection, Engineering Specifications Generation, Data Standards, Knowledge-Intensive CAD. Fundamentals of Numerical Control, Programming

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of CNC Machines, Programmable Logic Controllers (PLC's). Integration of the Computer Controller Machine Tool. Case Study of 5-Axis Machining.

Recommended Books

- 1. V.B. Anand: Computer Graphics and Geometric Modeling for Engineers, John Wiley and Sons, 1993.
- H.B. Kief and T.F. Waters: "Computer Numerical Control", A CNC Reference Guide, GLECOE, McGraw-Hill, 1992
- S. Finger, T. Tomiyama and M. Mantyla: Knowledge Intensive Computer Aided Design, Kluwer Academic Publications, 1998

ME 5384 ECO-DESIGN AND MANUFACTURING SYSTEMS (3)

Introduction, Industrial Production, consumer Products, Environmental Impact Lifecycle Assessment, Goal and Scope Definition, Inventory, Impact Assessment. Computer Modeling of Product Systems. LCA as a Tool in Eco-Design, Design for Recycling/Reuse, Energy, Raw Materials, Waste, Disposal, Labeling of Materials and Products. Design for Disassembly, Inverse Manufacturing, Impact of Take Back of Products. Automated Disassembly and Separation Systems. Case Studies and Project.

Recommended Books

H. Wenzel, M. Hausschild, and L. Alting: Environmental Assessment of Products, Vol. 1, Methodology, Tools and Case Studies in Product Development, Chapman and Hall, London, U.K., 1997.

ME5385 ARTIFICIAL INTELLIGENCE IN DESIGN AND MANUFACTURING (3)

Introduction to AI. 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.

Recommended Books

Artificial Intelligence: A Guide to Intelligent Systems by Michael Negnevitsky

ME 5391 APPLICATIONS AND SELECTION OF MATERIALS (3)

Design process and materials selection methodology. Basic material properties and materials selection charts. Selection of materials and shape. Case studies in materials selection. Multiple constraints and compound objectives.Interaction of materials, processing and design. Environmental issues in materials and process selection. Selection and use of materials in various engineering applications. Economics of materials and manufacturing processes.

Recommended Books

- Materials Selection in Mechanical Design, 3rd Edition, 2005 by Michael F. Ashby, Butterworth and Heinemann, Oxford.
- 2. Selection and Use of Engineering Materials, 3rd Edition, 1997 by J A Charles, F A A Crane and J A G Furness, Butterworth and Heinemann, Oxford.

ME 5392 MECHANICAL BEHAVIOR OF MATERIALS (3)

Overview of Mechanical Behavior, Elastic Behavior, Dislocations, Plastic Deformation in Single and Polycrystalline Materials. Strengthening of Crystalline Materials, Viscoelasticity, Deformation of Noncrystalline Materials, High Temperature Deformation and Fracture of Materials. Fracture and Fatigue of Engineering Materials.

Recommended Books

- 1. T.H. Courtney, Mechanical Behavior of Materials, 2nd ed. (McGraw Hill; Boston) 2000.
- 2. K.J. Bowman, Mechanical Behavior of Materials.)John Wiley; Hoboken, NJ) 2004
- 3. G.E. Dieter, Mechanical Metallurgy, 3rd ed. (McGraw Hill New York) 1986
- R.W. Hertzberg, Deformation and Fracture Mechanics of Engineering Materials, 4th ed. (J. Wiley & Sons; New York) 1995
- M.A. Meyers and K.K. Chawla, Mechanical Metallurgy; Principles and Applications. (Prentice-Hall; Englewood Cliff, NJ) 1984.
- ME 5390 SPECIAL TOPICS RELATED TO MECHANICAL ENGINEERING DESIGN (3)
- ME 5398 TECHNICAL REPORT WRITING AND RESEARCH METHODOLOGY (2)

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, Quantitative 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)

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Institute of Mechatronics Engineering

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.

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DIRECTOR

Prof. Dr. Sayed Riaz Akbar Shah Ph.D. (USA)
PROFESSOR
Dr. Muhammad Tahir Khan Ph.D. (Canada)
ASSISTANT PROFESSORS
Dr. Haji Faridullah Khan Ph.D. (Canada)
Dr. Izhar-ul-Haq Ph.D. (UK)

	· · ·
Dr. Kamran Shah	Ph.D. (UK)
Dr. Shahzad Anwar	Ph.D. (UK)
ngr. Muhammad Akmal	M.Sc (USA)
ngr. Sheraz Ali Khan	M.Sc (Pak)

LECTURERS

ngr. Zubair Ahmad	M.Sc (Pak)
ingr. Ms. Nayyar Fazal	M.Sc (Pak)
ngr. Muhammad Tufail	M.Sc (Bangkok)



Mechatronics Engineering

- 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

Specialization	Seats reserved for open merit	Seats reserved for rationalized fee basis	Total
Automation and Control	10	10	20

CORE COURSES

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

Course No.	Course title	Credits
MtE 5101	Advance Manufacturing Automation	3
MtE 5103	Reconfigurable Machine Tool Design	3
MtE 5104	Laser Applications in Engineering	3
MtE 5105	Drives & Control in Industrial Automation	3
MtE 5106	Micro-fabrication	3
MtE 5107	Advanced Mechatronics Systems Design	3
MtE 5108	Advanced Industrial Control	3
MtE 5109	Advanced Micro-Electromechanical Systems	3
MtE 5110	Advanced Micro & Nano Fabrication Technology	3
MtE 5111	Microrobotics	3
MtE 5113	Advanced Control Engineering	3
MtE 5114	Computer Applications in Robotics	3
MtE 5116	Biomechatronics	3
MtE 5117	Multidisciplinary Engineering Design Optimizatio	n 3
MtE 5119	Robotics I	3
MtE 5120	Advanced Robotics	3
MtE 5121	Robotics II	3
MtE 5122	Fuzzy Logic Control	3
MtE 5123	Advanced Digital Systems	3
MtE 5125	Machine Learning	3
MtE 5128	Advanced Digital Signal Processing	3
MtE 5129	Digital Image Processing	3
MtE 5130	Machine Vision	3

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
- Micro/Nano Electro-Mechanical Systems (MEMS & NEMS)

LIST OF APPROVED COURSES

MtE 5101 ADVANCE MANUFACTURING AUTOMATION (3)

Introduction to automation, Building blocks for automation, Advanced Automation Functions, Levels of Automation, Hardware components for automation and process control, material handling and identification technologies. Numerical control and CAD/CAM, computer aided part programming (APT language, structure and subroutines), Application of computer for design. Benefits of CAD. Geometric modelling techniques - Multiple view 2D input, Wire frame geometry, Surface models, Geometric entities - Curves and Surfaces, Solid modelers, Feature recognition. Computer Integrated Manufacturing, Interfacing, Local area networks and standards, Flexible Manufacturing Systems, Artificial intelligence in the design of FMS, Artificial intelligence in process planning (Group Technology).

Recommended Books:

- 1. C. Ray Asfahl, (1992), "Robots and Manufacturing Automation" John Wiley & Sons, Inc.
- M. P. Groover, (2007) "Automation, Production Systems and Computer Integrated Manufacturing" 3rd Edition, Prentice Hall

MtE 5102 ENGINEERING PROJECT MANAGEMENT (3)

Introduction to project management, Project Life Cycles, Project initiation, selection, approval, and preliminary scope statement, Project Planning Process. Work Break Down Structure, Time, cost & human resource scheduling, Quality, Risk, Procurement, and Communication Management, Project execution process; work performance information and deliverable management, Team management and information distribution. Monitoring & Controlling, Earned Value Management, Risk Monitoring and Forecasting, Scope verification, change control process, and quality controlling. Project Closing; contract closing and project closing with lesson learned, Code of professional ethics and responsibility.

Recommended Books:

- 1. Project Management: A Systems Approach to Planning, Scheduling, and Controlling Tenth Edition, by Haroldkerzner, Wiley.
- 2. Project Management: A Managerial Approach by Jack R. Meredith and Samuel J. Mantel, John Wiley & Sons.
- 3. A guide to the project management body of knowledge, 4th edition, Project Management Institute, 2008, ISBN #978-1-933890-51-7.

MtE 5103 RECONFIGURABLE MACHINE TOOL DESIGN (3)

Globalization and Decentralization of Manufacturing, New Trends in Production, General Characteristics of Reconfigurable Manufacturing Systems. Comparison with Dedicated and Flexible Systems, Enabling Technologies and Reconfiguration Characteristics Reconfigurable Machines, Status/Progress in Reconfigurable Manufacturing Systems, Reconfigurable Manufacturing Equipment (Manufacturing Equipment Types, Reconfigurable Machine Tools) Design Methodology for Reconfigurable Machine Tool Design, Challenges in the Design of Reconfigurable Machine Tools, Reconfigurable Fixtures for Automotive Engine Machining and Assembly Applications, Control Systems for RMS and Methods of their Reconfiguration, Future Trends, Economics of RMS, Virtual Production – Computer Model-Based Planning and Analyzing

Recommended Book:

 Hoda A. Elmaraghy (2009), "Changeable and reconfigurable manufacturing systems", ISBN: 978-1-84882-066-1, Springer-Verlag London Ltd.

MtE 5104 LASER APPLICATIONS IN ENGINEERING (3)

Basics of lasers covering fundamentals of laser operation, their variety, optical components, beam delivery and properties of focused radiation, Components of industrial laser systems including motion systems and beam delivery systems, Laser materials processing covering the interaction of a laser beam with materials, phase changes produced and why some lasers are better at processing some materials than other lasers, Industrial applications of lasers including, Laser deposition process, laser cutting, laser welding, laser surface texturing, laser drilling. Laser applications in alignment, gauging, interferometry, holography and inspection. Laser safety and classification.

Recommended Books:

1. W. M. Steen (2003), "Laser Material Processing",

Springer-Verlag, London.

- 2. Elijah Kannatey-Asibu, Jr. (2009), "Principles of laser materials processing", John Wiley & Sons, Inc.
- 3. John C. Ion (2005), "Laser Processing of Engineering Materials principles, procedure and industrial application", Elsevier Butterworth-Heinemann.

MtE5105 DRIVES AND CONTROL IN INDUSTRIAL AUTOMATION (3)

Overview of drives and control (measurement, actuation, power moderation, and control) Electric Drives (overview of Electric drives, electric motors), power electronics(DC to DC Converter, DC to AC Converter, AC to AC Converter, AC to DC Converter), position, velocity and acceleration measurement sensors, Piezoelectric Drives, Control System in Servo Drives, Digital Communication Protocols, Trends in Motion Control.

Recommended Book:

Tan Kok Kiong and Andi Sudjana Putra (2011), "Drives and Control for Industrial Automation" Springer-Verlag London L

MtE 5106 MICRO-FABRICATION (3)

Miniaturization application, Lithography, Pattern transfer with dry etching techniques, Bulk micromachining, surface micromachining, LIGA and micromolding, SU-8 molding and electroplating, soft lithography techniques, Top-down and bottomup manufacturing, Multi-User MEMS-Process (such as Silicon-On-Insulator, Poly MUMPs and Metal MUMPs), micro sensors, micro actuators, micro fluidics, power MEMS, lab on the chip, Low cost microfabrication techniques.

Recommended Books:

- 1. Fundamentals of Microfabrication: The Science of Miniaturization by Marc J. Madou, CRC press, USA.
- 2. Introduction to Microfabrication by Sami Franssila, John Wiley and Sons Ltd, UK.
- 3. Handbook of microlithography, micromachining, and microfabrication by P. Rai-Choudhury, SPIE Press.

MtE 5107 ADVANCED MECHATRONICS SYSTEM DESIGN (3)

Overview of Mechatronics (Industrial applications, design approach, Functions, Integration and Information processing for Mechatronic system) Modeling and simulation of physical systems(Modeling of Electromechanical systems, Rigid body models, Dynamic Models, Mechanical System Modeling), Fluid Power Systems, Sensors and actuators, Fundamentals of time and frequency, Types and characteristics of sensor and actuators, Control design of Mechatronic system, Computers and Logic Systems, Fault analysis in Mechatronic system.

Recommended Books:

- 1. The Mechatronics Handbook by Robert H. Bishop CRC Press, 2002
- Mechatronic Systems Devices, Design, Control, Operation and Monitoring by Clarence W. de Silva CRC Press, 2008

3. Mechatronics by W. Bolton, Pearson Education, Asia, II-edition, 2001

MtE 5108 ADVANCED INDUSTRIAL CONTROL (3)

Design and operational characteristics (Programmable logic controllers, I/O devices), PLC information and communication techniques (Digital systems, I/O processing), Programming Methods (Ladder and functional block programming, IL, SFC and ST Programming methods), Programming techniques (Internal relays, Jump and call, timers, counters, shift registers, data handling), HMIs and SCADA systems.

Recommended Books:

- 1. W. Bolton, (2009) "Programmable Logic Controllers", 5th edition, Elsevier
- 2. John F. (2003) "Programmable Controllers- An engineer's guide", 3rd edition, Elsevier Plc group.
- 3. Stuart A. Boyer (2009) "SCADA: Supervisory Control and Data Acquisition" 4th edition, ISA.

MtE5109 ADVANCED MICRO-ELECTROMECHANICAL SYSTEMS (3)

Overview of MEMS and microsystems, applications and uses of MEMS technology, working principles of microsystems, microactuators, microsensors, micro-domain forces, microfabrication, Lithography, thin-film deposition methods, etching techniques, device architecture, design rules and fabrication procedures, RF MEMS, micro-optoelectro-mechanical-systems (MOEMS), and micro biosensing. MEMS actuation mechanisms (such as, thermal, electrostatic, electromagnetic and piezoelectric), MEMS sensing mechanisms (such as capacitive, peizoresistive, optical, and biotransduction), mechanics for MEMS design, MEMS packaging.

Recommended Books:

- 1. Micromachined Transducers Sourcebook by Gregory T.A. Kovacs, WCB/McGraw-Hill, Singapore.
- 2. Mems & Microsystems Design & Manufacture by Tai-Ran Hsu, Tata McGraw-Hill, New Delhi.

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.
- 2. Micro-Nanofabrication: Technologies and Applications by Zheng Cui, Springer, USA.

3. Microfabrication for Industrial Applications by Regina Luttge, Elsevier, Netherlands.

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.
- 2. Microsystem technology and microrobotics by Sergej Fatikow and Ulrich Rembold, Springer-Verlag, Berlin, Germany.
- 3. Cellular robotics and micro robotic systems by Toshio Fukuda and Tsuyoshi Ueyama, World Scientific Publishing Co., Singapore.
- 4. Automated nanohandling by microrobots by Sergej Fatikow, Springer, USA.

MtE 5112 NANOROBOTIC SYSTEMS (3)

Introduction of nanorobotic system, Potential application of nanorobots, Nanorobotic components, Design methodology of nanorobots, Bio-nanorobotic structures, Characterization of Bionano and Nanorobotic devices, Prototyping of nanostructures, Future prospects.

Recommended Books:

1. Design, Modeling and Characterization of Bio-

Nanorobotic Systems by Mustapha Hamdi and Antoine Ferreira, Springer, USA.

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.

Frequency-response method: Response to sinusoidal inputs; Bode diagrams; Polar plots; Experimental determination of transfer functions; Control-systems design by the frequency-response approach.

Recommended Books:

- 1. Ogata, K., Modern control engineering Fifth edition. Prentice Hall, 2009
- 2. Ogata, K., Modern control engineering Fourth edition. Prentice Hall, 2001
- 3. Kuo B.C., Golnaraghi F., 2003, Automatic Control Systems, 8th Ed., Wiley

MtE 5114 COMPUTER APPLICATIONS IN ROBOTICS (3)

3D modeling, assembly and drawing of robotic system using Pro-E. Application of 3D modeling in conceptual design and iterations for robotic systems. Project based Assignments in Pro-E. Modeling and simulation of robot components in FEM softwares (such as Comsol, Ansys etc.). Modeling physical phenomenon and mathematical equations using MATLAB. (such as matrix analysis, numerical visualization, building of graphical user interface, data analysis). Modeling robot trajectory, control or dynamics using matlab. Project based Assignments in MATLAB.

Recommended Books:

- 1. Getting started with Pro/Engineer by Robert Rizza, Prentice Hall, USA.
- 2. Inside Pro-Engineer by Utz and Ulman, Onward Press, USA.
- 3. Introduction to Matlab 7 for Engineers by William John Palm, McGraw-Hill, USA.
- 4. Introduction to MATLAB by D.M. Etter, McGraw Hill, USA.
- 5. Robotics, Vision and Control: Fundamental Algorithms in MATLAB by Peter Corke, Springer, Germany.

MtE 5115 BIOMEDICAL ENGINEERING (3)

A historical prospective of biomedical engineering, biomedical applications, autonomy and physiology, biomechanics, biotechnology, biomaterial, tissue engineering, prostheses and artificial organs, rehabilitation engineering, biochemical reactions and enzyme kinetics, bioinstrumentations, biomedical sensors, artificial actuators, biosignal processing, bioelectric phenomena, biomedical transport phenomena, radiation imagine, medical imaging, biomedical optics and lasers. Bio-MEMS, micro-needle technology, lab-on-a-chip technology, microfabricated stents for heart patients, implantable micro devices, micro drug delivery systems.

Recommended Books:

- 1. Introduction to Biomedical Engineering by John D. Enderle and Joseph D. Bronzino, Elsevier, USA.
- 2. Biomedical Engineering: Health Care Systems, Technology and Techniques by Sang Suh, Varadraj P. Gurupur and Murat M. Tanik, springer, USA.
- 3. Introduction to Biomedical Engineering: Biomechanics and Bioelectricity by Douglas Christensen, Margon & Claypool Publishers, USA.
- 4. The biomedical engineering handbook by Joseph D. Bronzino, Springer-Verlag, Germany.

MtE 5116 BIOMECHATRONICS (3)

Overview of mechatronic systems, biosensors, mechanical sensors, controller, actuator biomechanics and signal processing. Introduction to biomechatronics, applications of biomechanics, bioelectronic circuits, design and control of biomechatronic systems. active and passive limb prostheses, hearing prostheses, visual prostheses, sensory, substitution, electrocardiography, artificial hearts, respiration aids, artificial muscles, medical imaging, robotic surgery, bio-compatible materials, biomedical embedded systems and BioMEMS. Future of bionics and biomechatronics.

Recommended Books:

- 1. Introduction to Biomechatronics by Graham M. Brooker, SciTech Publishing, USA.
- 2. Biomechatronics in Medicine and Health Care by

Raymond K. Y. Tong, Pan Stanford Publishing, Singapore.

3. The Bionic Human by Allan B. Cobb, The Rosen Publishing Group, USA.

MtE5117 MULTIDISCIPLINARY ENGINEERING DESIGN OPTIMIZATION (3)

Multidisciplinary optimization procedure in design processes: basic ideas, aims, scope, concepts, old and new non-gradient methods in engineering optimization, optimal engineering design by means of stochastic optimization methods, response surface approximations for engineering optimization, modeling and approximation strategies in optimization: global and mid-range approximations, response surface methods, genetic programming, low/high fidelity models, strategies for modeling, approximation, and decomposition in genetic algorithms based multidisciplinary design.

Recommended Books:

- 1. Emerging methods for multidisciplinary optimization by Jan Blachut and Hans Eschenauer, Springer-Verlag, USA.
- 2. Multidisciplinary design optimization: state of the art by Natalia M. Alexandrov and M. Yousuff Hussaini, SIAM, USA.

MtE 5118 GENETIC ALGORITHMS (3)

An overview of Design Optimization (Design parameters and constraints, objective function, mathematical modeling, design spaces, design optimization, Multi-objective optimization). Evolutionary computation, genetic algorithms (introduction, biological background, conventional optimization and search techniques, a simple genetic algorithm, comparison with other optimization techniques), applications of genetic algorithms, terminologies and operatives of genetic algorithms (such as gene, chromosomes, fitness, populations, search space, encoding, breeding, schemata, convergence criteria and search termination etc.), advanced operators and techniques in genetic algorithms, classification of genetic algorithms, genetic programming, genetic algorithms optimization problems, genetic algorithms implementation using Matlab or C++. Limitations of genetic algorithms.

Recommended Books:

- Introduction to genetic algorithms by S. N. Sivanandam and S. N. Deepa, Springer-Verlag, Germany.
- 2. An introduction to genetic algorithms by Melanie Mitchel, The MIT Press, USA.
- 3. An introduction to genetic algorithms for scientists and engineers by David A. Coley, World Scientific Publication Co., Singapore.
- 4. Genetic Algorithms in Search, Optimization and Machine Learning by D E Goldberg, Pearson Education, USA.
- 5. Genetic Algorithm Toolbox User's Guide, Department of Automatic Control and Systems Engineering, University of Sheffield.

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:

- 1. Mark W. Spong, Seth Hutchinson and M. Vidyasagar, Robot Modeling and Control , John Wiley and Sons, 2006.
- 2. Sciavicco, L. and Siciliano, B., Modeling and Control of Robot Manipulators, McGraw Hill, New York, 2nd Ed, Springer-Verlag, 2000.
- 3. S. B. Niku, Introduction to Robotics, Analysis, Systems, Applications, Prentice Hall, 2001.
- 4. J.J. Craig, Introduction to Robotics: Mechanics and Controls, 3rd Ed., Addison Wesley, 2003.

MtE 5120 ADVANCED ROBOTICS (3)

Forward and inverse kinematic, motion trajectories, manipulator jacobian, Joint Space Dynamics, Newton-Euler Equations, Lagrange Equations, Equations of Motion, Control: methods of control, robot control hierarchy, control of single joint and multiple link manipulators.

Recommended Books:

1. Mark W. Spong, Seth Hutchinson and M. Vidyasagar, Robot Modeling and Control , John Wiley and Sons, 2006.

- 2. Sciavicco, L. and Siciliano, B., Modeling and Control of Robot Manipulators, McGraw Hill, New York, 2nd Ed, Springer-Verlag, 2000.
- 3. S. B. Niku, Introduction to Robotics, Analysis, Systems, Applications, Prentice Hall, 2001.
- 4. J.J. Craig, Introduction to Robotics: Mechanics and Controls, 3rd Ed., Addison Wesley, 2003.
- 5. C.W. de Silva, Control, Sensors and Actuators, Prentice Hall, 1989.

MtE 5121 ROBOTICS II (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 system tuning, industrial applications.

Recommended book:

1. Karray, F. O. and de Silva, C. W., Soft Computing and Intelligent Systems Design-Theory, Tools, and Applications (Addison Wesley, 2004), ISBN 0-321-11617-8.

MtE 5123 ADVANCED DIGITAL SYSTEMS (3)

Algebraic structures for digital logic functions, synthesis of logic functions with multiplexers, realization of logic functions with PLA's, realization with FPGA's, Introduction to FPGA's and various Xilinx FPGA chips esp. Spartan III (due to availability of boards) or latest. Design cycles for digital systems using hardware description languages, Verilog, digital arithmetic, floating point math, design of data path components adders, fast adders, multipliers, encoders, decoders and extension towards the design of signal processing architectures using Verilog along with the synthesis, simulation and implementation of such systems on FPGA boards.

Recommended books:

- 1. Fundamentals of Switching Theory and Logic Design, Jaakko T. Astola, Springer
- 2. Advanced Digital Design with the Verilog, Michael D. Ciletti, Pearson

MtE 5124 STATISTICAL SIGNAL PROCESSING (3)

Probability and measure theory, random variables, vectors and processes, expectation and averages, Estimation theory, Gaussian Random processes, Poisson counting processes, ergodicity etc..

Recommended book:

1. Introduction to Statistical Signal Processing, Robert M. Gray, Cambridge University Press.

MtE 5125 MACHINE LEARNING (3)

Introduction to machine learning and statistical pattern recognition, supervised learning

(generative/discriminative learning, parametric/ non-parametric learning, neural networks, support vector machines); unsupervised learning (clustering, dimensionality reduction, kernel methods); learning theory (bias/variance tradeoffs; VC theory; large margins); reinforcement learning and adaptive control, applications of machine learning, such as to robotic control, data mining, autonomous navigation, bioinformatics, speech recognition, and text and web data processing.

Recommended book:

1. Pattern Recognition and Machine Learning, Christopher Bishop, Springer, 2006.

MtE 5126 WEARABLE ROBOTS (3)

Introduction to wearable robots, application and scope of wearable robots, basis for bioinspiration and biomimetisum in wearable robots, kinematics and dynamics of wearable robots, network architecture for wearable robots, human-robot cognitive interaction, human-robot physical interaction, wearable robots technologies, communication networks for wearable robots, actuation module for wearable robots, wearable upper limb robots, wearable lower limb and fullbody robots.

Recommended Books:

- 1. Wearable robots: biomechatronic exoskeletons by Jose L. Pons, John Wiley & Sons Ltd, USA.
- 2. Advances in Robot Kinematics: Motion in Man and Machine by Jadran Lenarcic, Springer, USA.
- 3. Intelligent wearable interfaces by Yangsheng Xu,

Wen J. Li and Ka Keung Caramon Lee, John Wiley & Sons Ltd, USA.

MtE 5127 INDUSTRIAL POLLUTION CONTROL (3)

Source and Characteristics of Industrial Air Pollution and its control techniques, Source and Characteristics of Industrial wastewater; Environmental Quality Standards for Industrial wastewater, Wastewater treatment Processes, Equalization, Neutralization, Sedimentation, Flotation; Adsorption, Ion exchange, and biological processes, case studies of air and wastewater treatment for Iron and steel industries, cement industries; paper and pulp industries, Tanning industries and Chemical industries, Impact of Environmental Regulations.

MtE 5128 ADVANCED DIGITAL SIGNAL PROCESSING (3)

Theory and Applications of Discrete Time Signals and Systems; The Z-Transform; Input/Output Relationships, Discrete Time Networks; Sampling Continuous time signals; Discrete Fourier Transform; Programming Considerations, Digital Filters, IIR Filters, FIR Filter Design Techniques, Filter Design by Modelling, Quantization Effects, Signal Processing Algorithms, DSP System Design, DSP Chips; Digital Filter Implementation. Filter and System Examples

Recommended books:

- 1. Discrete Time Signal Processing, Oppenheim, Schaffer
- 2. Digital Signal Processing, Proakis, Monalakis, Prentice Hall Inc.

MtE 5129 DIGITAL IMAGE PROCESSING (3)

Image sampling and quantization, color, point operations, segmentation, morphological image processing, linear image filtering and correlation, image transforms, eigenimages, multiresolution image processing, wavelets, noise reduction and restoration, feature extraction and recognition tasks, and image registration.

Recommended books:

- 1. Digital Image Processing, R. C. Gonzalez and R. E. woods, 2nd edition, Pearson Education, Inc., 2002.
- Digital Image Processing using MATLAB, R. C. Gonzalez, R. E. Woods and S.L. Eddins, Pearson Education, Inc., 2004.

MtE 5130 MACHINE VISION (3)

Machine vision, Image Formation and Filtering, Grouping and Fitting, Image segmentation, Texture analysis, Shape analysis, Object Modeling, , Stereo Vision and Depth Analysis, Calibration, Dynamic Vision, Change Detection, Segmentation using motion, motion correspondence, Image Flow, Segmentation using a moving camera, Tracking, Object Recognition, Optical Flow.

Recommended Books:

- 1. Machine Vision, Ramesh Jain, Rangachar Kasturi, Brian G. Schunck, Published by McGraw-Hill, Inc.
- 2. Computer Vision: Algorithms and Applications by

Richard Szeliski, 2nd edition, Pearson Education, Inc., 2002.

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:

- Research Methodology: Methods and Techniques by C. R. Kothari, New Age International Ltd. Publishers, New Delhi.
- 2. Technical Writing for Success by Darlene Smith-Worthington and Sue Jefferson, South-Western Cengage Learning, USA.

MtE 5197 SPECIAL TOPICS RELATED TO MECHATRONICS ENGINEERING (3)

MtE 5198 MASTER'S THESIS (6) MtE 5199 Ph.D. THESIS (1-9)

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Department of Mining Engineering

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 guarrying 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.

CHAIRMAN Engr. Amanul Mulk PROFESSOR Prof.

Dr. Noor Mohammad	Ph.D. (UK)	

ASSOCIATE PROFESSORS

Engr. Siddique Akbar	M.Sc (Pak)
Engr. Feroz Din	M.Sc (Pak)

ASSISTANT PROFESSORS

Engr. Ehtashamullah Khan	M.Sc. (UK)
Engr. Nisar Mohammad	M.Sc. (Pak)
Engr. Salim Raza	M.Sc. (Pak)
Dr. Ishaq Ahmad	Ph.D. (Germany
Dr. Khan Muhammad	Ph.D. (UK)
Dr. Asif Khan	Ph.D. (Germany

Lecturers

r. Safi-ur-Rehman	Ph.D (Pak)
ngr. Saira Sherin	M.Sc. (Pak)
ngr. Talat Bilal	M.Sc. (Pak)



M.Sc (USA)



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Mining Engineering

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.
- 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:

- 1. Directorate General of Mines and Minerals, Govt. of Khyber Pakhtunkhwa.
- 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).

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LIST OF APPROVED COURSES

MinE 5510 MINE ADMINISTRATION AND LABOUR RELATIONS (3)

Essentials of management, Decision making, Communication, Managerial accounts, History of Labour movement world wide, Labour movement in Pakistan, Unions, Strikes, Lockouts, Negotiations, Agreements.

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 applicaitons; Definition and basics of research, research purpose; Design of research methods, identificaiton of research problem, Literature review, selection of data collection techniques, Seleciton of representative sample, writing of research proposals, Data colleciton 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)

Smelter schedule selection of comminution method for specific concentrating process and machines. Advanced classification techniques in conjunction with autogenous grinding. Comprehensive study of gravity concentration along with wet magnetic separation. Optical sorting technique and electrostatic/ electrodynamic separation methods. Control review of methods and techniques for mineral properties modification to suit process. Recent advances in froth flotation. Agglomeration, selective flocculation and its application.

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)

Properties of coal and coal impurities. Sampling of coal. Raw coal preparation. Size reduction of coal. Screening wet concentration of coarse and fine coal. Dense medium separation Hydraulic concentration. Froth flotation. Agglomeration. Dry concentration. Mechanical and thermal dewatering. Dust collection in coal processing and handling. Coal storage and loading plant waste and Environmental consideration.

MinE 5525 ADVANCED ROCK MECHANICS (3)

Rock pressure theory and theory of failures. Rock

bursts. ground control and supports. Mining with high technology equipment. Concept of finite method. Empirical methods of design.

MinE 5530 ADVANCED MINE VENTILATION NETWORKS AND ENVIRONMENT (3)

Thermodynamics analysis of mine air flow. Network analysis of mine resistance. Methane drainage. Ventilation in radio active mines. Instrumentation and controls. Hazardous mine dusts and control. Role of computers in ventilation networks.

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

A history of computers and their applications. Advent in Mining Industries Mainframes. Minis and Micros. Programming languages. Some advanced programming related to Mining applications. Computer aided design of Mine workings.

MinE 5540 OPERATIONS RESEARCH (3)

Scope of systems engineering. Production scheduling and planning. Linear programming. simplex methods. Transportation and assignment problem. Critical Path Methods. Management and cost control systems.

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, solidsolid 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:

- i. Introduction to Particle Technology, 2nd Ed. by M. Rhodes. John Wiley & Sons 2008.
- M.E.Fayed & L. Otten: Handbook of Powder Science and Technology, 2nd Ed. Chapman & Hall, 1997.

Reference Books:

- I. Fine particles processing Vol I and II by Somasunderan AIME publisher.
- 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.

MinE 5560 UNDERGROUND MINE DESIGN (3)

Pressure Theories. Theoretical and physical modelling methods. Design of Support. Support Characteristics. Functional reliability of reinforcement. Subsidence and strata control.

MinE 5561 SUBSIDENCE ENGINEERING (3)

Prediction of surface subsidence: profile function method, influence function method, finite element method, computer models for subsidence prediction. Surface structure damages: types of damages, criteria for damages. Prevention of surface structural damages: mining layout, protective measures for housel pipes, highways, and bridges. Subsidence measurement techniques: measurement of surface movement, measurement of subsurface movement, measurement of structural damages.

MinE 5562 ADVANCED SURFACE MINE DESIGN (3)

Analysis of elements of surface mining operations and design of surface mining system components including ore estimates, unit operations, equipment selection, ultimate pit limits, long and short range planning, haul road, waste dump planning, and cost estimation. Study of 3D ultimate pit limit design algorithms, mathematical programming for sequencing and scheduling of open pit and quarry operations, various approaches to cutoff grade optimization for open pit mining operations, computerized ore control, haul road and dump design, and truck dispatching. Case studies of various renowned surface mining operations.

MinE 5563 MINE SYSTEM SIMULATION (3)

Introduction to probability theory, discrete probability distributions, fundamentals of queuing theory, queuing models, cost analysis of queuing models, deterministic and probabilistic simulations, manual simulation, principles and practices of computer simulation in the design and analysis of operating mines.

MinE 5564 SURFACE COAL MINE DESIGN (3)

Reserve estimation, surface coal mine design methods, pit geometry, surface coal mining in gentle and steep deposits, dragline, bucket wheel excavator, and shovel-truck operations.

MinE 5565 ROCK MECHANICS IN MINE DESIGN (3)

Design process in Mining Engineering. Design approach for excavation in Rock. Input parameters for design. Empirical observations and analytical methods of design. Integrated design.

MinE 5570 ROCK SLOPE ENGINEERING (3)

Designing of civil and mining Slopes. Modes of slope failures. Economic and planning considerations. Graphical representation. Probablistic approach to slope design.

MinE 5571 ADVANCE EXCAVATION ENGINEERING (3)

Introduction, classification of structures, strategies for subsurface investigation and testing, advance design methods, advance excavation methods for underground structures. Advance design philosophies for tunnels in soils, swelling and squeezing grounds and seismic zones. Support of underground opening and rock reinforcement, ground water control.

MinE 5575 PROJECT MANAGEMENT (4)

Introduction: Project Management vs Leadership, Management process and managerial functions, Project life cycle, Project manager: Role and responsibility, qualities of a good manager.

Project Initiation

- 1. Project evaluation and Selection: Project selection models: criteria, nature and types project proposal.
- 2. Project Organization: Project as part of functional organization, pure project organization, matrix organization and mixed organization. Chosing an organizational form.
- 3. Project Planning: Initial project coordination, system integration, elements of project plan, linear responsibility chart-exercise.

Project Implementation:

1. Introduction to budgeting: Budgeting methods, cost estimation.

- 2. Scheduling: Network techniques CPM, PERT and Gantt Chart Exercise.
- 3. Monitoring and information System. Designing a monitoring system, Data collection, report types, common reporting problems, milestone reporting.
- 4. Project Control: Purpose, physical assets, human resources, and financial control.

Project Termination: When to terminate a project: Termination by extinction, termination by Inclusion, termination by integration, Project History Report.

Other Aspects of Project Management

- 1. Quality Management: Demings' fourteen principles for continuous improvement, introduction to statistical process control.
- 2. Risk Management An Introduction.
- 3. Conflict Management An Introduction.
- 4. Negotiation Techniques.
- 5. Interviewing as Business Function: Types of Interview.

MinE 5576 SPATIAL DATA ANALYSIS AND RESERVE ESTIMATION (3)

Review of elementary statistics, univariate and bivariate description of data, spatial description, spatial continuity, introduction to variograms, random function models, reserve estimation techniques, fundamental concepts of
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. Thermodynamis - 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)

Department of Computer Systems Engineering

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.

CHAIRMAN

Dr. Laiq Hasan

Ph.D. (The Netherlands)

ASSISTANT PROFESSORS

Dr. Nasir Ahmad	Ph.D. (UK)
Dr. Nasru Minallah	Ph.D. (UK)
Dr. Aftab Khan	Ph.D. (UK)
Dr. Arbab Masood	Ph.D. (Pak)
Dr. Safdar Nawaz Marwat	Ph.D. (Germany
Dr. Salman Ahmed	Ph.D. (Canada)
Dr. Abdul Hafeez	Ph.D. (USA)
Dr. Samad Baseer	Ph.D. (Thailand)
Engr. Zahid Wadood Mufti	M.Sc. (Pak)
Engr. Ihsan Ul Haq	M.Sc. (Pak)

LECTURERS

Engr. Sumayyea Salahuddin	M.Sc. (Pak)
Engr. Madiha Sher	M.Sc. (Pak)
Engr. Muniba Ashfaq	M.Sc. (Pak)
Engr. Tariq Afridi	M.Sc. (Germany
Engr. Asif Ali Khan	M.Sc. (Pak)
Engr. Rehmat Ullah	M.Sc. (Pak)
Engr. Durr-e-Nayab	M.Sc. (Pak)

LAB ENGINEERS

Engr. Shakir Ullah	M.Sc. (Pak)
Engr. Amaad Khalil	M.Sc. (Pak)
Engr. Sidra Gul	M.Sc. (Pak)
Engr. Jebran Khan	B.Sc. (Pak)



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Computer Systems Engineering

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:

- 1. C. Perkins, "Ad Hoc Networking", 1st Edition, Eddison-Wesley.
- 2. C. Perkins, "Mobile IP", 1st Edition, Prentice Hall.
- 3. W. R. Stevens, B. Fenner and A. M. Rudoff, "Unix

Network Programming; The Sockets Networking", 3rd Edition, Eddison-Wesley.

4. J. Matthews, "Computer Networking: Internet Protocols in Action", John Wiley & Sons.

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. Recommended book:

1. William Stallings, "Network Security and Cryptography".

CSE5604 Network Modeling and Simulation (3)

This course provides the student with a Quantitative Approach to Networking and covers analytic methodologies for design and evaluation of communication networks. Contents of the course are: Network Performance and source characterizations, Network Delay, Delay Jitter and Playout Delay, QoS Objectives, Traffic Models, Scheduling, Shaped Traffic Analysis, Bandwidth Sharing and control techniques. Routing Engineering Issues, Algorithms for Shortest Path Routing, on Demand Routing, MPLS(Multi-Protocol Label Switching).

Recommended Books:

1. Anurag Kumar, D. Manjunath and Joy Kuri, "Communication Networking".

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. T. S. Rappaport, "Wireless Communication: Principles and Practice", 2nd Edition, Prentice Hall, 2002.
- 2. S. Haykin and M. Moher, "Modern Wireless Communications", Prentice Hall, 2004.
- 3. R. Steele, C. Lee and P. Gould, "GSM, CDMA, One and 3G Systems", 2001, John Wiley & Sons.
- 4. M. R. Karim, M. Sarraf, "W-CDMA and cdma2000 for 3G Mobile Networks", 2002, McGraw-Hill.

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-systembased multicast, distributed file systems, instant messaging, P2P-VoIP, etc.

CSE5609 Delay Tolerant Networks (3)

Delay Tolerant Networks (DTN) routing, energyaware routing protocol for DTNs, a routingcompatible 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 mobilityassisted 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, Bernaulli 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:

- 1. Gregory F. Lawler, "Introduction to Stochastic Processes", Second Edition 2006.
- David. Stirzaker, "Stochastic processes and models", Oxford University Press 2005.

CSE5612 Advanced Digital Signal Processing (3)

This course provides an in depth knowledge of theory and applications of DSP. The following topics are covered: Overview of Sampling and Quantization, FIR Filter Design, IIR Filter Design, State Space representation of Digital Signal Processing Systems, Spectrum Estimation. Signal Modeling and Levinson Recursion. Introduction to Wiener Filtering and Adaptive Signal Processing, Least mean square algorithm and a final Project.

Recommended Books:

- 1. Alan V Oppenheim, Ronald W Schafer, John R Buck, "Discrete Time Signal Processing".
- 2. Monson. H. Hayes, "Statistical Digital Signal Processing and Modeling".

CSE5613 Advanced Digital Image Processing (3)

Advanced Digital Image Processing investigates algorithms and techniques for a variety of imaging applications. The techniques build on the background that is established in the course, Introduction to Digital Image Processing, which focuses on basic image processing methods.

This course contains the advanced topics in digital image compression. The different topics covered in this course includes, Image Enhancement in Spatial Domain, Image Enhancement in Frequency Domain, Image Restoration, Color Image Processing, Morphological Image Processing, Image Segmentation, Object Recognition, Wavelet and Multi-resolution Processing, Feature Detection & Classification. The group projects enable the students to work on substantial designs that require the understanding of the task domain, exploration of solution methods, and implementation of a selected approach. Each team presents a preliminary plan, an approach with feasibility analysis, and a final demonstration.

Recommended Book:

- 1. Digital Image Processing 3rd Edition by Gonzalez and Woods Prentice Hall, 2008.
- 2. Digital Image Processing Using MATLAB by Gonzalez, Woods, Prentice Hall, 2004.

CSE5614 Speech Processing (3)

This course introduces the basic principles of digital processing of Speech signal. The topics covered includes speech production, Speech signal analysis, Speech perception and Automatic speech recognition.

Recommended Books:

1. Rabiner and Schafer: Theory and Applications of Digital Speech Processing, Prentice Hall, 2010.

CSE5615 Signal Detection & Estimation (3)

To acquaint students with various methods to detect and estimate the signal in dynamic systems.

The topics covered include: Introduction to estimation, Minimum Variance unbiased Estimation, Kramer Rao lower bound, Linear estimators, General minimum variance unbiased estimation, Best linear unbiased estimators, Maximum likelihood estimation, Least Square approach, Bayesian Estimation and elements of Detection theory.

Recommended Books:

- 1. Steven M. Kay, "Fundamentals of Statistical Signal Processing: Estimation Theory".
- 2. Steven M. Kay, "Fundamentals of Statistical Signal Processing: Detection Theory".

CSE5616 Information Theory and Coding (3)

The concepts of source and channel. Measure if information, entropy, and mutual information. The noiseless coding theorem. The noisy coding theorem. Channel capacity: symmetric and nonsymmetric channels. Rate-distortion theory. Basics of multiple user information theory.

Linear codes: parity and generator matrices, syndrome error correction and detection capability, minimum distance. Performance bounds of linear codes, hamming and Golay codes, Galois fields, shift register implementation, cyclic codes. BCH decoding algorithm, burst correction codes. Recommended Books:

 Robert J. McEliece, "The Theory of Information and Coding", Student Edition, Cambridge University Press 2004.

CSE5617 Image and Video Compression (3)

Image and Video compression techniques can be regarded as the backbone of digital communication and multimedia systems. This course is designed to give a broad overview of the basics of digital images and videos and to familiarize students with the theory and standards of image and video compression and coding. The students will be familiarizedwith the theory and standards of image and video compression/coding. Assignments and home works will be geared towards this goal. This course is intended to be a foundation course for the multimedia concentration area.

Recommended Books:

- 1. Mohammed Ghanbari, "Standard Codecs: Image Compression to Advanced Video Coding Video", The Institution of Electrical Engineers (IEE), London, UK, 2003.
- Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Addison-Wesley Publishing Company, 2003.
- 3. Yun Q. Shi, Huifang Sun, "Image and Video Compression for Multimedia Engineering:

Fundamentals, Algorithms, and Standards", CRC Press, 2000.

4. Peter Symes, "Digital Video Compression", McGraw-Hill companies, Inc. 2004.

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:

- 1. Fred Halsall, "Multimedia Communications Applications, Networks, Protocols & Standards", Pearson Education Ltd.
- K.R. Roa, Zoran S. Bojkovic and Dragorard A. Milanvanovic, "Multimedia Communication Systems, techniques, standards and networks, Pearson Education Ltd.

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 realtime, 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.

Recommend Reading:

 Introduction to TMS320C6000 DSP Optimisation. October 2011, http://www.ti.com/lit/an/ sprabf2/sprabf2.pdf

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 (normal case), Hidden Markov Models (HMM), Artificial Neural Networks (ANN), Features extraction for classification, Dimensionality reduction and design of experiments on classifiers.

Recommended Book:

1. R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification (2nd ed), John Wiley & Sons, 2000

CSE5621 Artificial Intelligence (3)

Representation and space search. Heuristic search. Predicate calculus. Knowledge representation and knowledge engineering for expert systems. Rulebased, hybrid, and OO systems. Semantic nets, frames and natural language. Theorem provers. Overview of planning. Learning, neural nets. Use of AI languages. Feed forward neural network models, single and multilayer neural networks, learning strategy in computers, supervised and unsupervised neural learning algorithms, back propagation.

Recommended Books:

1. Stuart J. Russell, "Artificial Intelligence: A Modern Approach", 3rd Edition, Prentice Hall, 2009.

CSE5622 Computer Vision (3)

Image processing: edge detection, segmentation, local features, shape and region description in 2D and 3D. Insight from human vision studies. Representation for vision: object models, synthetic images, matching, gaps, algorithms. Interference, production system, synthetic networks. Planning spatial reasoning for robot vision.

Recommended Books:

1. Linda G. Shapiro, "Computer Vision", Prentice Hall, 2001.

CSE5623 Computational Bioinformatics (3)

The course provides an overview of computational molecular biology and discusses various fields of bioinformatics, more specifically sequence alignment, its types and applications. It details pair wise global alignment methods like Dot plot and Needleman-Wunsch algorithm and local alignment methods like the Smith-Waterman. It explains Sequence Alignment Heuristics like FASTA and BLAST and Multiple Sequence Alignment methods like ClustalW and HMMER.

Recommended Books:

- 1. Alexander Isaev, "Introduction to mathematical methods in bioinformatics", Springer 2006.
- 2. Venkatarajan S. Mathura, "Bioinformatics: a concept-based introduction", Springer 2009.

CSE5624 Nonlinear Systems (3)

Introduction to Linear and Nonlinear Systems, Approximate analysis of Nonlinear Systems -

describing functions, Krylov and Bogoliubov asymptotical method and Typskin Locus. Forced Oscillations – jumps resonance. Stability analysis -Liapunov criterion. Lure problem and Popov Method.

Recommended Books:

1. Hassan K. Khalil, "Nonlinear Systems", 3rd Edition, Prentice Hall, 2001.

CSE5625 Digital Control Systems (3)

Introduction to state space and System Modeling, State Space Representation of Dynamic Systems, optimal Control, Sampled Data Systems and Discrete time Systems, Digital Control and dynamic analysis of Discrete Systems, Quantization Effects, Sample Rate Selection, System Identification.

Recommended Books:

1. Gene F. Franklin, J. David Powell and Michael Workman, "Digital Control of Dynamic Systems".

CSE5626 Digital Communication Systems (3)

Analysis and design of digital communications systems for voice, video and data. Digital coding of waveforms: Nyquist criteria, inter symbol interference (ISI), Partial response signaling, Practical considerations in design of signals for modems and recording media. Digital switching and integrated services digital networks. Recommended Books:

- Bernard Sklar, "Digital Communications: Fundamentals and Applications", 2nd Edition, Prentice Hall.
- 2. John G. Proakis, Digital Communications, 5th Edition, McGraw Hill.

CSE5627 Optimization Techniques (3)

Parameter optimization problems, and theory of minima and maxima. Optimization problems for dynamic systems, calculus of variations, the maximum principle and the Hamilton-Jacobi equation. Optimization problems with constraints, optimal feedback systems, Numerical solution of optimal problems.

Recommended Books:

- 1. V. Chvatal, "Linear Programming", 1983 Freeman, TVX 2806.
- 2. Dimitris Alevras and Manfred W. Padberg, "Linear Optimization and Extensions", Springer 2001.
- 3. Alexander Schrijver, "Theory of Linear and Integer Optimization", 1999, Wiley, TLG 1627.
- Jiri Matousek and Bernd Gartner, "Understanding and Using Linear Programming", Springer, 2007, TVX 3577.

CSE5628 Advanced Software Engineering (3)

Ideas and techniques for designing, developing and 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.
- 2. Roger S. Pressman, Software Engineering : A Practitioner's Approach, McGraw Hill.

CSE5629 Advanced Computer Architecture (3)

Review of technology trends: Cost, Performance and qualitative analysis, Instruction set Architecture, Instruction Level Parallelism, Advanced Pipelining, VLIW and superscalar Processor, Data Path and Controller Design, Peripheral Busses, Memory and Caches, DSP Architecture and Applications, Multiprocessor System.

Recommended Books:

1. David Money Harris "Digital Design and Computer Architecture", Morgan Kaufmann, 1st edition, 2007.

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 Book:

1. Alberty Y. H. Zomay, (Eds.), "Parallel & Distributed Computing Handbook", McGraw-Hill Series on Computer Engineering.

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:

- 1. Joseph J. F. Cavanagh, "Digital Computer Arithmetic, Design and Implementation".
- 2. Behrooz Parhami, "Computer Arithmetic, Algorithms and Hardware Designs".

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 architecture, Network on Chip and other relevant topics will be included with the consent of the instructor.

Recommended Book:

1. Frank Vahid and Tony Givargis, "Embedded System Design: A Unified Hardware/Software Introduction", John Wiley & Sons, Inc.

CSE5633 High Performance Computing (3)

This course is intended for students who are interested in computing-intensive research. Attention is paid to algorithms that are being used within a diversity of research areas. The scaling behavior of these algorithms in case of an increasing problem size and/or increasing number of processing elements is analyzed. By analyzing certain applications with respect to their computeintensive character, possible bottlenecks will be determined. Based on performance analysis, it will be indicated how the effect of those bottlenecks can be reduced. The goal is to learn how to get a high performance with the available hardware resources.

Recommended books:

1. Georg Hager, Gerhard Wellein, "Introduction to High Performance Computing for Scientists and Engineers (Chapman & Hall/CRC Computational Science)".

CSE5634 Analysis of Algorithms (3)

This course teaches techniques for the design and analysis of efficient algorithms, emphasizing methods useful in practice. Morespecifically, this course will focus on following topics,

- To provide a Comprehensive understanding of Computer Algorithms.
- To provide in detailed understanding to Analysis and Design of Algorithms.
- To become familiar with solution of classical problems and to study how these solutions can help in solving other related problems.
- To study and design approximate algorithms for problems, which cannot be solved by exact algorithms.

Recommended Book:

1. Thomas H Corman, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 2nd edition, 2001.

CSE5635 Integrated Electronic / VLSI Design (3)

Algorithms for minimization of two-level and multilevel VLSI systems, optimization of sequential logic, completely specified and incompletely specified FSMs, technology mapping, floorplanning, placement, global and local routing, CMOS logic, design of combinational and sequential logic using CMOS, DC characteristics of CMOS circuits, Delay analysis and optimization of CMOS, Power analysis and optimization CMOS, Interconnects, Ultra low power circuits, scalability of transistors and their effects on performance.

Recommended books:

- 1. Jan Rabaey, "Digital Integrated Circuits".
- 2. Neil Weste et al., "CMOS VLSI design, a circuits and systems perspective".

CSE5636 Advanced Operating Systems (3)

Distributed operating system, parallel operating, system, overview of the operating systems: UNIX, DOS, VMS, Windows NT, Novell Netware 4.xx, Linux, memory management, multiprogramming, virtual paging, segmentation, principle of DOP, advanced features of DOP and parallel operating systems, and parallel operating systems.

Recommended Books:

- 1. William Stallings, Operating Systems: Internals and Design Principles, Prentice Hall
- 2. Andrew S. Tanenbaum, Modern Operating Systems, Prentice Hall
- 3. Yair Wiseman and Song Jiang, Advanced Operating Systems and Kernel Applications: Techniques and Technologies, Information Science Reference
- 4. Mukesh Singhal, Niranjan Shivaratri, Advanced Concepts In Operating Systems, McGraw-Hill

CSE5637 Advanced Database Design & Management (3) Introduction to file systems and databases, Relational

Database Model, Relational Algebra for databases, Complex SQL Queries, Internet database environment, Distributed database management systems, Object-oriented databases, Client/Server Systems, Data warehousing, ETL for Data warehousing, memory resident databases, database optimization, advanced configuration options for database files.

Recommended Books:

- 1. Abraham Silberschatz, Henry Korth and S. Sudarshan, Database System Concepts, McGraw-Hill
- 2. Hoffer, Prescott and McFadden, Modern Database Management

CSE5638 Advanced Object-Oriented Programming (3)

The design patterns of Gamma, Helm, Johnson, and Vlissides. The C++ Standard Template Library (STL), a generic programming paradigm that has been adapted to the C++ programming language, and is an extensible framework for generic and interoperable components.

Recommended Books:

1. Robert Lafore, Object Oriented Programming using C++, Sams Publishing

CSE5639 Advanced Data Structures (3)

Sparse matrix transpose and multiplication, List insertion and deletion, lists of available space.

Inorder, preorder, and postorder traversal of trees. Topological sorting. Binary search trees, AVL trees, B-Trees, and tries. Dynamic hashing.

Recommended Books:

- 1. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein, Introduction To Algorithms, The MIT Press.
- 2. Peter Brass, Advanced Data Structures, Cambridge University Press.

CSE5640 Management Information System (3)

Why information systems, difference between Computers and Information Systems, Information systems and Organizations, Information systems and Decision Making, Enhancing Management Decision Making (DSS, GDSS, QFD).

Recommended Books:

1. James O. Brien and George Marakas, "Management Information Systems", McGraw-Hill, 9th edition, 2010.

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. Jack R. Meredith and Samuel. J. Mantel, "Project Management a Managerial Approach".

CSE5691 Tech. Report Writing & Research Methodology (2)

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?".
- 2. Graziano, A. M., Raulin, M. L., "Research Methods. A Process on Inquiry".

CSE5690 Special Topics (3) CSE5699 Master's Thesis (6) CSE6699 Ph. D. Thesis (1-9)

Department of Chemical Engineering

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.

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Ph.D. (France)

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Dr. M. Imran Ahmad	Ph.D. (UK)
Dr. Asmatullah	Ph.D. (UK)
Engr. Ammad Ullah Khan	M.Sc. (Pak)
Engr. Sultan Ali	M.Sc. (Pak)

LECTURERS

Dr. Naseer Ahmad Khan	Ph.D. (Australia
Dr. Irshad Ali	Ph.D. (Canada)
Engr. Hayat Khan	M.Sc. (S.Korea
Engr. S. Naveed-ul-Hassan	M.Sc. (Pak)
Engr. Qurat-ul-Ain	M.Sc. (Pak)
Dr. Muhammad Daud	Ph.D. (KSA)
Engr. Mansoor-ul-Hassan	M.Sc. (Pak)
Engr. Saira Bano	M.Sc. (Pak)
Engr. Unsia Habib	M.Sc. (Pak)
Engr. Amir Muhammad	M.Sc. (Pak)
Engr. Wajid Ali	M.Sc. (Pak)



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RESEARCH PROJECTS AND FACILITIES

The mission of the Department of Chemical Engineering at University of Engineering & Technology, Peshawar is 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 hightech 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 upto-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 SPECIALIZAITON

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

ChE 5621	Process Dynamics and Control	
ChE 5618	Process Simulation and Optimization	
ChE 5619	Advanced Heat Transfer	
ChE 5620	Advanced Chemical Engineering Thermodynamics	
ChE 5607	Mathematical Methods in Chemical Engineering	
ChE 5626	Advanced Transport Phenomena	
Elective Courses		
ChE 5601	Membrane separation processes	
ChE 5602	Multi-Phase flow	

ChE 5603 Biochemical engineering

Β.

- ChE 5604 Experimental Design and analysis
- ChE 5606 Advanced Chemical Process Analysis and Design
- ChE 5608 Polymer Engineering
- ChE 5609 Application of Corrosion Engineering in Process Industries
- ChE 5610 Heat Recovery System Design
- ChE 5611 Separation System Design
- ChE 5612 Management in Technical Organizations
- ChE 5613 Industrial Waste Management
- ChE 5614 Occupational Health and Safety in Process Industries

ChE 5623	Computational Fluid Dynamics
ChE 5624	Clean Coal Technology
ChE 5627	Technical Report Writing & Research Methodology
ChE 5698	Special Topics related to Chemical Engineering
ChE 5699	Master's Thesis
ChE 6699	Ph.D Thesis

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 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

Introduction to simulation in process systems engineering, model building framework, conservation principles, model analysis, solution strategies. Model reduction framework Linearization. Deterministic optimization methods, stochastic optimization. Dynamic optimization: Indirect methods, sequential methods, simultaneous methods. Parameter estimation and parametric sensitivity.

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 therm-odynamics 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 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 5606 ADVANCED CHEMICAL PROCESS ANALYSIS AND DESIGN (3)

Introduction to process analysis and simulation; models and model building; models based on transport phenomena principles; principles of subsystem; responses to 'typical inputs; linearization of nonlinear models; transfer functions; stability; principle of systems analysis; decomposition of large-scale systems; system stability and sensitivity; system determinacy. Application of process system engineering to selected chemical engineering problems. Optimum design of large complex processes.

ChE5607 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 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)

Mathematical modeling and identification of chemical processes. State-space process representation and analysis: stability, observability, controllability and reachability. Analysis and design of advanced -control systems: internal model control, dynamic matrix control and model predictive control. Synthesis of multivariable control systems: interaction analysis, singular value decomposition, decoupler design. Continuous and sampled-data systems, on-line process identification. State and parameter estimation techniques: Luenberger observer and Kalman filter. Knowledge of Laplace transforms, material and energy balances, computer programming and matrix algebra is required.

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 TECHONOLOGY

Introduction to clean coal technology. Classification of coal. Energy mix, Contribution of coal to energy mix. Technology for coal utilization: coal combustion, gasification, liquefaction, cogasification. Principles of coal gasification, gasification, gasifier types, commercial gasification systems. Emissions control strategies for power plants. Chemical looping combustion technology, packed bed and fluidized bed reactors using coal and syngas.

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)

Introduction to Heat Integration, Energy targeting and Pinch Analysis, Heat exchanger network design for maximum heat recovery, Heat exchanger design, Utilities provision, Capital and Energy Trade-Offs, Automated design of heat exchanger networks, Retrofit of heat exchanger networks, Heat engines, heat pumps, and refrigeration, Heat integration of reactors, Heat integration of distillation, Heat integration of other separation processes, Process modifications, Data extraction, Putting it into practice.

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)

Principles of Management, Communication Planning, Leadership, Human Resource Management, Organizational Culture, Change Management, Technology Management, Innovation & Creativity, Introduction & Applications of Management Tools.

ChE 5613 INDUSTRIAL WASTE MANAGEMENT (3)

Characteristics of industrial wastes, Processes for treatment of industrial waste, Legislative and regulatory concerns, Environmental quality standards for industrial waste waters, Applications of biological treatment to industrial waste waters, Environmental management in process industries, Waste minimization and resource recovery in process industries, Cleaner production technologies, Case studies on waste management: Pulp & Paper, Tannery, Textile, Fertilizer, Sugar, Petroleum, Pharmaceutical, and Corn Starch industries.

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

Chemical Engineering

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 (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, 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 ENG-INEERING (3)

- ChE 5699 MASTER'S THESIS (6)
- ChE 6699 Ph.D. THESIS (1-9)

Department of Computer Software Engineering

INTRODUCTION

Software Engineering is the discipline that deals with creating and maintaining software applications by applying technologies and practices from computer science, Project management, Engineering, Application domains and other fields. A misconception about software engineering is that it is just 'coding' or programming. However, it is not just 'coding' but also is the thorough understanding of the entire process, from planning to Design, Development, Testing and Deployment.

Software engineers have a firm grounding in the concepts of Computer Science. However, this discipline varies widely from computer science as it deals with actual implementation of software through software engineering principles. This is similar to other engineering disciplines like chemical engineering. As chemical engineering deals with the application of physical science like physics chemistry, similarly software engineering deals with the applications of computer sciences.

DEPARTMENT MISSION

The primary mission of this program in Software Engineering is to teach and equip students with knowledge of the concepts, techniques, skills and tools for developing modern large-scale software systems. Students with a Software Engineering degree will be prepared for professional careers in the software industry, an economic sector that is experiencing high rates of growth and is increasingly critical to the technological advancement and the competitiveness of the state and the nation.

The post graduate program in computer software engineering was started from spring 2011 in the Mardan campus. Currently it offers the Master's of Science and P.hD. degrees in the field of Software Engineering. The graduate program is designed to develop professional

COORDINATOR	
Dr. Muhammad Usman	Ph.D. (S.Korea
CHAIRMAN	
Dr. Sadaqat Jan	Ph.D. (UK)
ADVISOR POSTGRADUATE STUDIES	
Dr. Ibrar Ali Shah	Ph.D. (UK)
ASSOCIATE PROFESSOR	
Dr. Sadaqat Jan	Ph.D. (UK)
ASSISTANT PROFESSORS	
Dr. Ibrar Ali Shah	Ph.D. (UK)
Dr. Muhammad Usman	Ph.D. (S.Korea
Dr. Sohail Khan	Ph.D. (S.Korea
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Engr Shaharvar	M Sc (Pak)

Engr. Zafar Ali Shah

Engr. Shabir Ahmad

Engr. Lubna Gul



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M.Sc. (Pak)

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skills, teaching the fundamentals of software development and management of software technology. The program accommodates both working professional and fresh graduates. The classes are offered in the evenings and on weekends. Major areas of expertise of the teaching staff include software quality assurance, software testing, application of optimization techniques to software engineering, search based software engineering, human computer interaction in the context of software engineering, computer vision and computer networking.

WHY TO STUDY SOFTWARE ENGINEERING?

According to commission of bureau of Labor and statistics USA, Computer Software Engineers are expected to have the second highest growth (45%) with an annual average wage of 70,000\$ out of the 30 occupations despite the current economic crisis. In Pakistan although there are no official figures, the chances of getting a job are even higher. Being a developing country, there is a lot of need to computerize departments In order to compete with other nations computerization is an important aspect and could bring transparency in processes. In today's world growth without computer is not imaginable. There are also lots of opportunities in software industry in Pakistan as they are growing rapidly. In addition, there also lot of opportunities in developed nations.

ELIGIBILITY CRITERIA

1. BS (SE/CS) 4 years degree program,

OR

 Computer Science conversion course two years degree program referred to as MCS or M.Sc. (Computer Science),

OR

 BCS 3-year program degree applicants may be provisionally admitted in the MS (SE) program. Candidates will be required to take additional courses to complete credit hour requirement of minimum 120 before being formally enrolled in the MS (SE) program.

Under eligibility criteria 1-3 the university/department may recommend additional deficiency courses, from the BS (SE) curriculum, considering the deficiency of the candidates.

OR

4. 16-years education engineering degree.

Under eligibility criterion 4 candidates will be required to complete the deficiency coursework prior to the MS (SE) coursework to ensure the prerequisite competency in SE.

The deficiency coursework will be determined on the basis of the core SE courses of the BS (SE) degree.

LIST OF APPROVED COURSES

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

CORE COURSES

SE5901 SOFTWARE SYSTEM DESIGN AND ARCHITECTURE

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.

SE5902 REQUIREMENT ENGINEERING

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.

SE5903 SOFTWARE QUALITY ASSURANCE

Software Quality, Quality Assurance and Quality Engineering introduction.

TESTING: Concepts, Issues, and Techniques, Test Activities, Management, and Automation, Coverage and Usage Testing Based on Checklists and Partitions, Input Domain Partitioning and Boundary Testing, Coverage and Usage Testing Based on Finite-State Machines and Markov Chains, Control Flow, Data Dependency, and Interaction Testing, Testing Techniques: Adaptation, Specialization, and Integration. QUALITY ASSURANCE BEYOND TESTING: Defect Prevention and Process Improvement, Software Inspection, Formal Verification, Fault Tolerance and Failure Containment, Comparing Quality Assurance Techniques and Activities.

QUANTIFIABLE QUALITY IMPROVEMENT: Feedback Loop and Activities for Quantifiable Quality Improvement, Quality Models and Measurements, Defect Classification and Analysis, Risk Identification for Quantifiable Quality Improvement, Software Reliability Engineering.

SE5904 SOFTWARE PROJECT MANAGEMENT

Executive Overview of Project Management, Bounding Project Scope, Project Classification Frameworks, Creating the Project Charter, Leading and Managing the Project Team, Work Breakdown and Organizational Structures, Task Planning, Labor-Driven Activities, Project Network. Modeling, Project Management Software, Resource Leveling and Project Budget, Project Control, Project Quality Management, Contracting and Sub-contracting, Risk Management, Evaluating, Directing, and Closing Out a Project, Business Ethics.

SE5913 RESEARCH METHODS

Research methods introduction. Types of research methods. Quantitative and qualitative research. Research ethics. Experimental design.

ELECTIVE COURSES

SE5905 SOFTWARE MEASUREMENT AND METRICS:

Measurement theory (overview of software metrics, basics of measurement theory, goal-based framework for software measurement, and 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.

SE5907 SOFTWARE CONFIGURATION MANAGEMENT

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.

SE5908 SOFTWARE DEPENDABILITY

Dependability, it's impairment and means, dependability models, methods and techniques with respect to their effect on software dependability. A practical project by each student or a group of students to apply dependability engineering to a software system.

SE5909 INTELLIGENT SYSTEM DESIGN

Introduction to Intelligent Systems, Adaptation, Learning, Memory Development, Instinctive Behaviour, Artificial Neural Network (ANNs), History of ANN, Mode of Operation, Learning rules, History of ANN, Mode of Operation, Training of ANNs, Back propagation, Types of Neural Networks, Kohonen Self Organizing Maps, Hopfield Networks, Spiking Neural Networks (SNN), Heb's Rule, Spiking time dependant plasticity networks, Neuro-Evolution, Topology and Weight evolutionary ANNs), Neuroevolution of Augmented topologies, Neural development.

SE5910 SOFTWARE DESIGN PATTERNS

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

SE5911 BIO-INSPIRED COMPUTATION

Introduction to bio-inspired computation, Conventional and un-conventional programming, Evolutionary Computation, Evolutionary Strategies and Evolutionary Programming, Genetic Algorithms and Genetic Programming, Genetic Algorithms Methods and implementation, Mutation and Cross Over, Genetic Encoding, Fitness Landscape, Selection Methods, Cartesian Genetic Programming, Ants Colony Optimisation, Swarm Intelligence, Coevolution, Evolutionary Development.

SE5912 SOFTWARE TESTING

Faults, Failures, and their Costs, Oracles and Principles, Model Based Testing, Models, Finite State Machines, Decision Tables & Markov Chains, Design and Unit testing

Design Metrics, Static Analysis, Domain, Coverage, Integration Testing, System Testing 1: Functional, Negative, Scenario, Mutation, Measuring and Monitoring the Test Process, Security & Reliability Testing, Regression, Performance, and Web Application Testing, Test Planning, Automated Software Testing, Search Based Software Testing.

SE5914 DIGITAL IMAGE PROCESSING

Introduction to Digital Image Processing, examples of image processing, Color fundamentals, color models; Image Enhancement: Gray-level transform, histogram processing, arithmetic/logic operation, Spatial filtering, 2D Fourier transform, Frequency domain smoothing, sharpening, implementation details, Image degradation model, Noise models, restoration using spatial filtering with noise only degradation, Review for midterm, Wiener filtering, constrained least square filters, geometric transformation, basic pixel relations, set theory, logic operators, skeleton, Boundary descriptors, shape numbers, Fourier descriptors, statistical moments; Elements of information theory, Lossless and Lossy coding, Huffman coding, skeleton, Boundary descriptors, shape numbers, Fourier descriptors, statistical moments; Elements of information theory, Lossless and Lossy coding, Huffman coding.

SE5915 WEB ENGINEERING

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 PHP and MySQL.

SE5916 FORMAL METHODS

To be furnished by the instructor as many different options are available.

SE5917 SOFTWARE ENGINEERING ONTOLOGY

Ontology Engineering: Principles, Methods, Tools, and Languages. Using Ontology in Software Engineering. Development of Ontologies for SWEBOK (Software Engineering Body of Knowledge): Issues and Techniques.

Some Ontologies for Software Development: Ontologies for Requirements, Design, Maintenance, Measurements,

Use of Ontologies in Domain Oriented Software Development Environments Comparative Study of Semantics Coverage in Ontologies as per SWEBOK. Alignment of Different Available Ontologies.

SE5918 SEMANTIC WEB ENABLED SOFTWARE ENGINEERING

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.

SE5919 MODEL DRIVEN SOFTWARE DEVELOPMENT

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, Metamodeling, MDSD- capable target architecture, Building domain architectures, code generation techniques, Model Transformation, MDA standards, testing, versioning. Current research topics as decided by instructor.

SE5920 MACHINE LEARNING APPLICATION IN SOFTWARE ENGINEERING

Introduction to Machine Learning and Software Engineering, ML Applications in Prediction and Estimation, ML Applications in Property and Model Discovery

ML Applications in Transformation, ML Applications in Generation and Synthesis

ML Applications in Reuse, ML Applications in Requirement Acquisition, ML Applications in Management of Development Knowledge.

SE5921 SOFTWARE CASE TOOLS & APPLICATIONS

The students will be appraised of; Case tools & techniques, CASE in software development process, Traditional CASE methodologies, Emerging CASE methodologies, OO Design, Specific CASE tools, specialized design tools, Managing CASE methodologies.

As part of course, students will be assigned a real life problem for development through CASE tools.

SE5922 INFORMATION SYSTEM SECURITY

Security Introduction, Cryptography, Essential

Security Concepts, Trusted Systems and Security Models, Authentication, Kerberos, Availability, DoS Attacks ATM Networks – Performance and Attacks, IP Network Performance – QoS and DoS, Key Management for Secure Networks, Security Protocols, Security Protocols – continued, Biometrics, TEMPEST, Student final project "presentations".

Se5923 DESIGN AND ANALYSIS OF NETWORK SYSTEMS

Basic Concepts in Networking, Example Networks and Network Components, Introduction to Network Analysis, Architecture, and Design, Network Requirements Analysis: Concepts, Network Requirements Analysis: Process, Flow Analysis, Network Architecture, Addressing and Routing Architecture, Network Management Architecture, Performance Architecture, Security and Privacy Architecture, Selecting Technology for the Network Design, Interconnecting Technologies with the Network Design.

SE5924 DATA WAREHOUSING

DW fundamentals, need for a DW, decision support vs. transaction processing, evolution of a DW. Business requirements as the driving force for the DW, matching information to classes of users. Dimensional modeling.

Architecture and Infrastructure, data extraction, transformation and loading, data quality. Selected

Computer Software Engineering

de-normalizations, horizontal and vertical partitioning, materialized views, Physical design, Data mart design, web data warehousing.

Current topics in data warehousing.

(Course contents taken from http://suraj.lums. edu.pk/~cs543s05/ by Dr. Asim Karim).

SE5925 HUMAN COMPUTER INTERACTION, A SOFTWARE ENGINEER'S PROSPECTIVE

Introduction: Significance of Human-Computer Interaction, Conceptual Framework for Human-Computer Interaction, Usability, User Experience and Software Quality, Multidisciplinary Nature of Human-Computer Interaction, Cognitive Frameworks, Cognitive Processes, Mental Models and Implementation Models, Interaction Frameworks, Design of Everyday Things, Interaction Paradigms and Styles, Beginners, Experts, and Intermediates

Lifecycle Models: Development Lifecycle Models, User-Centered Design Approaches, Goal-Directed Design Process

Evaluation Methods and Techniques: Evaluation Paradigms, Evaluation Frameworks, Heuristic Evaluation, Usability Testing.

User Research and Modeling: Qualitative Research, Personas and Goals

Requirements and Design: Scenarios and Task Description, Needs, Requirements and Specifi-

cations, Conceptual Design and Physical Design, Prototyping Methods and Techniques.

Goals and Barriers: Software Posture, Orchestration and Flow, Excise, Navigation and Inflection, Undo, Files and Save, Software Attributes, Data Retrieval, Data Entry, Designing for Different Needs.

Visual Design Principles: Designing Look and Feel, Metaphors, Idioms, and Affordances,

Mice and Manipulation (1): Direct Manipulation and Pointing Devices, Selection, Drag and Drop, Manipulating Controls, Objects and Connections, Controls and Their Behaviors: Windows, Using Controls, Menus, Toolbars and Tool Tips, Dialogs Communicating with Users: Errors and Alerts, Notifications and Confirmations, Help and Documentation, Installation Process.

Se5926 SPECIAL TOPICS RELATED TO SOFTWARE ENGINEERING

Department of **Telecommunication Engineering**

The field of Telecommunication Engineering is evolving rapidly with new technological standards introduced with the passage of time. Look back 10 years in the past, when very few of us had a mobile phone, our internet connection, in general, was as powerful as required by the then text based websites and when none of us could be a part of any social networks. However, technological evolution in the field of Telecommunication has unknowingly changed our lifestyle. We now have access to powerful computational machines in the form of mobile, handhelds bundled with user friendly software applications that are designed for any imaginable application scenario. Most of us now spend more time in the world of virtual social networks. Our forms of expressions are just a click away through online blogging and YouTube. We are emerging into an age where we are connected 'Any Time, Any where' through mobile networks.

Looking at where we are now, from engineering point of view, simply reflects the ground breaking inventions achieved through research in the field Telecommunication Engineering.

Why you should study M.Sc./Ph.D. in Telecommunication Engineering

Looking ahead in the near foreseeable future, we cannot think of any sector of the society where communication technologies will not have a vital role to play. From healthcare, governance, education, administration to agriculture and finance it is going to be the communication technologies that will define the future modus operandi of those business processes.

As a matter of fact, the demand for skilled human resource will increase as the pace and scope of the communication technologies will grow. In

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ASSISTANT PROFESSORS	
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Dr. Naveed Mufti	Ph.D (UK)
Dr. Sadiq Ullah	Ph.D (UK)
Dr. Taufeeg Ahmad	Ph.D. (China)
Dr. Akhtar Khalil	Ph.D (UK)
Engr. Sheraz Khan	M.Sc (Pak
Engr. Abid Jan	M.Sc (Pak)
Engr. Aziz Ahmad Khan	M.Sc (UK)
Engr. Jalal Khan	M.Sc (UK)
Engr. Shagufta Naz	M.Sc (Pak)
LECTURERS	
Engr. Sajjad Ali	M.Sc (Pak)

Engr. Zawar Hussain

Engr. Nagina Zareen

Engr. Humaira Rehman



M.Sc (USA)

M.Sc (Pak)

M.Sc (Pak)

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line with the foreseeable future requirements of the Telecommunication Industry and all related fields that demand highly skilled Telecommunication Engineers, the Telecommunication Engineering Department provides tailored-fit M.Sc, and Ph.D. programs.

The Objectives of Telecommunication Engineering Department are formulated to harness most of these challenges and strategies are formulated to incorporate all the required skills into our program.

Research Projects

The department of Telecommunication Engineering is at the forefront of innovation and excellence in Engineering through consistent and expanding research. Our faculty members have successfully collaborated with the local and international Industry to design Engineering solutions for our local problems. The department recently received a research grant of Rs. 25.5 million from the ICT R&D Fund Islamabad, for research and development under the project called 'Crop Estimation and Geographic Mapping System (CEGMaS)'.

Project CEGMaS will focus on identification and classification of tobacco crop and its seven species through the use of advance image processing techniques over Hyperspectral satellite imagery providing tobacco crop yield estimates to various stakeholders of the Tobacco Industry and the Government's regulatory bodies. CEGMaS will include the pilot regions of Shergarh (District Mardan) and Sawabi – both regions contribute to over 75% of the total tobacco grown in Khyber Pakhtoon Khwa. To enhance the accuracy of the estimation, CEGMaS will use GPS enabled smart phone applications developed during the project to collect 'ground-truth data'. The geographically mapped information will be available through a GIS for analysis by various stakeholders.

CEGMaS is a collaborative research project of UET, Peshawar and the Pakistan Space & Upper Atmosphere Research Commission (SUPARCO) and would last for 3 years. Among many other benefits of the project, the project also provides funding for two Ph.D. studentships. It is hoped that the project will help in capacity building of UET in areas including Remote Sensing and GIS.

Research Avenues

- Cognitive Networks
- Cooperative Networks
- Analogue Network Coding
- Error Control Coding
- Space Time Coding
- Long Term Evolution (LTE) Advance
- Mobile Adhoc Networks (MANETs)
- Routing Protocols
- Energy Efficiency in Communication Networks (Green Communication)
- Medium Access Control Protocols
- Network Security
- Antenna Design
- Signal Processing
- Image Processing
- Machine to Machine Communication

LIST OF APPROVED COURSES

TE-5101 Stochastic Processes

Introduction to Theory of Probability, Axioms of Probability, Probability Space, Repeated Trials, Random Variables, Density and Distribution Functions, Characteristic Function, Statistical Moments, Function of Several Random Variables. Probabilistic Transformation and Central Limit Theorem, Random Processes, Introduction to Stochastic Processes, Poisson Process, Wiener and White noise Processes, Stationary and Nonstationary Processes, Stochastic Calculus, Correlation and Power Spectra, Stochastic Differential Equations, Linear System Analysis, Differential Equations with Random Forcing Functions, Spectral Method for Stationary Systems, Nonstationary Response Analysis, Markov Processes, Langevin's Equation and Brownian Motion, Markov Processes, Ito's Equation, Louiville and Fokker-Planck Equations, Nonlinear Stochastic Systems, Method of Moments of Fokker-Planck Equation, Nonlinear System Analysis, Nonlinear Stochastic Differential Equations, Perturbation Method, Equivalent Linearization Technique, Random Systems, Stochastic Differential Equations with Random Coefficients, Stochastic Stability, Introduction to Karhunen - Loeve Expansion.

TE-5102 Telecom Systems & Networks

The rationale behind this course is to provide the

student with an understanding of the evolution of telecommunication systems and networks from traditional Public Switched Telephone Network (PSTN), through the emergence of data networks, local area networks, integrated services digital network (ISDN), broadband ISDN, development of fast packet switching, to the Internet. An overview on the Role of Telecommunications in Developing Countries, Telecommunications Organizations, Telecommunication Standardizations and Services is also provided.

TE-5103 Advanced Digital Communication

Introduction. Mathematical models for communication channels, Review of probability theory, Review of stochastic processes, Mathematical models for information sources, Entropy and mutual information, Lossless data compression, Coding for discrete sources, Huffman coding and adaptive Huffman coding, Run-length coding, Arithmetic coding, The context weighting algorithm, The Lempel-Ziv algorithm, Grammarbased coding, Yang-Kieffer algorithms, Lossy data compression, Rate distortion function, Scalar guantization, Vector guantization, Communications with AWGN Interference, Probability of Error for various digital modulation methods, Comparison of digital modulation methods, Channel Capacity and Coded Modulation, Block and Convolutional Channel Codes, Convolutional codes, Trellis Coded Modulation.

TE-5104 Advanced Digital Signal Processing

Signal Processing of Sufficient Statistics, Binary and M-ary Signal Transmission in the presence of Noise, Non random and random parameter estimation, Karhunen-Loeve Expansion and Applications in Stochastic Processes, Detection and Estimation in white Gaussian Noise, Fading Channels: Performance Analysis, Suppression of Intersymbol Interference in Bandlimited Channels, Maximum Likelihood Sequence Estimation, Maximum a Posteriori Estimation, Soft Output Algorithms, Sequential Algorithm, Reduced Complexity Techniques, Application of Precoding for Equalization, Application to wireless Channels, Space-Time Processing, MIMO Systems, Performance Analysis in wireless environment, MIMO- OFDM, Signal Processing to mitigate Peak to Average Power Ratio, Techniques for Cancellation of Intercarrier Interference, Multiband Ultra Wideband (UWB), Statistical Signal Processing, Discrete Time Estimators, Algorithms for Channel Estimation, Applications in MIMO systems, Evaluation of different techniques, Multiple Access Techniques, Code Division Multiple Access (CDMA), Time Division Multiple Access (TDMA), Frequency Division Multiple Access, Combination of MIMO with Multiple Access Techniques, Analysis of Performance and Comparison, Applications in 3rd and 4th Generation Systems, Multiuser Detection, Elements of multiuser detection, Techniques in

CDMA: Interference Suppression, Space time processing, Turbo multiuser detection. Multiuser capacity, Advanced Receiver Techniques, Space Time Receivers: BLAST, Multipath mitigation and exploitation in MIMO-OFDM, Turbo Space Time Processing. Detailed Analysis of Receivers for 2nd and 3rd Generation Systems, Performance Evaluation and Comparison.

TE-5105 Antenna Design

Definitions of basic antenna properties: impedance. VSWR, bandwidth, directivity, gain, radiation patterns, polarization, Classification by Parameter: Directivity, Frequency and Size, Antenna Types: Independent Antennas, Aperture Antennas, Traveling Wave Antennas, Resonant Antennas, Phased Arrays, Electrically Small Antennas, Circularly Polarized Antennas. Monopoles, Dipoles, Folded Dipoles, Loops, Slots. Horizontally Polarized Antennas, Vertically Polarized Antennas, Environmental Considerations on Antenna Performance. Introduction to Antenna Elements. Microstrip Antenna Design and Design trade-offs, **Designing Microstrip patch for Short Range Wireless** Networks, Ground plane considerations, Baluns, Aperture Antenna Design, Horn Antenna, Reflector Antenna, Corner Reflector, Circularly Polarized Antennas, Helix Antenna, Crossed Dipole Antenna, Quadrifilar Helix. Need for Impedance Matching, Impedance Matching Networks. Broadband Configurations: Monopole, Feed, Dipole,

Bandwidth improvement techniques, Frequency Independence: Log-periodic Antenna, Spiral Antennas, Electrically Small Antennas: Definitions, Bandwidth and Quality Factor Consideration, Performance Limitations, Small Antennas: Dipole & Loop, Optimization Techniques for Small Antennas. Overview of Antenna Arrays, Antenna Array Types, Feed Network design considerations, Beam Steering and Shaping, Performance trade-offs, Antenna Array Examples. The Communication Link, Path Loss Calculations, RF path loss, Reflection, multipath and fading, Noise and interference, Polarization distortion. Diversity implementation. Power Calculations, Properties of Antenna Receivers, Apertures, Efficiency, Antenna Coupling, Performance Parameters. Fractal Antenna, RFIDs, Low Profile Antennas, Inverted L, Inverted F antennas, Planar Inverted F Antenna (PIFA), Ultra Wideband (UWB) Antennas, Performance & Properties of the above. Antennas in Wireless Applications, Wireless Cellular Antennas, Mobile Antennas, GPS, HF, UHF and VHF Communication Antennas, Antennas for Satellite Communication, Electronic Bandgap Materials and Perfectly Conducting (PEC) ground planes. Numerical Tools, Software packages.

TE-5106 Simulation and modeling

Introduction to Simulation and Modeling, Discrete-Event Simulation, Simulation of a Single-Server Queueing System, Alternative Approaches to Modeling and Simulations; Review of Basic Probability and Statistics; Estimation of Means, Variances, and Correlations, Confidence Intervals and Hypothesis Tests for the Mean, The Laws of Large Numbers; Random number generators; Simulation of discrete, continuous probability distributions and empirical distributions; tests on simulated distributions, rejection method, simulation of multivariate distributions, correlations, and stochastic processes, simulation of models of arrival processes, Poisson Processes, Nonstationary Poisson Processes, Batch Arrivals, tests on generators, Markov- Chain Monte-Carlo simulations; Variance-Reduction Techniques.

TE-5301 Research Methodology & Technical Writing

Introduction to the nature of research process, Types of research (experimental/nonexperimental), Steps of research (with emphasis on Engineering related research), Problem Identification, Literature review and information gathering and analysis techniques (simulation models, projections). Report Writers Pyramid, Business Letter Formats, Report Writing, Research Reports and Reference Formats, Resume Development/Cover Letter Writing, Public Speaking Units including emphasis on oral presentations. Steps in writing technical documents including research proposals, research grants applications, publishing research outcomes, finding the right platforms, Technology tools assisting research,
bibliography styles, determining impact of research, measuring the impact through various analytical scales including the citations, the impact factor, and performance parameters for evaluating research.

TE-5201 QoS in Telecommunication Networks

Introduction to High Speed Networks and Quality Aware Networks; Integrated Services Digital Netoworks (ISDN); Switched Multi-Megabit Data Service; Broadband Integrated Services Digital Network: Overview of ATM: ATM Laver Model and ATM Cell Structure; Network Node Interface; ATM Physical Layers; Line Coding; ATM Forum Specifications: 100 Mbps Fibre Based Physical Laver Interface; 155.52 Mbps Fibre Based Interface; The TC Sbulayer; 155.52 Mbps Sonnet Physical Layer; SONNET Frame Structure; Physical Layer Management; DS3 Physical Layer; Operation and Maintenance; ATM Layer Management; ATM Adaptation Layer; Different classes of service; SAR Operation; AALs; ATM Service Types; Quality of Service and ATM: Information Transfer Parameters for ATM Connections; Traffic Management in ATM Networks; Traffic Shaping and Traffic Policing; Leaky Bucket Algorithm; Window based Algorithms; Jumping Window Algorithm; Moving Window Algorithm; Signalling; Systems using ATM; System Architecture; Software Overview; ATM Card Components; Video and Metering Protocol; Interworking with ATM.

TE-5202 Teletraffic Engineering

Traffic Flows in Networks. Traffic Units and Parameters, Holding Time and Call Intensity, Offered Traffic and Carried Traffic, Congestion and Delay, Traffic Variations, Subscriber Behavior, Classical Loss Systems, Poisson Traffic Model, Erlang's Model, Binomial, and Engset's Models, Limited Availability, and Gradings, PJ Formula, Link Systems in Switching Networks, Dimensioning Tables and Charts, Computerized Aids, Delay Systems, Classical Waiting Time Systems, Classification of Queuing Models, Infinite Source Delay-Loss Systems, Limited Source Delay-Loss Systems, Traffic Measurements, Measurements Recommended by ITU-T, Measurement of Holding Times, and Traffic Intensity, Measurement Accuracy, Multi-Dimensional Traffic, Multidimensional Traffic Models, Overflow Traffic Modeling, ATM Traffic Characteristics, and Modeling.

TE-5203 Cellular Network Planning and Optimization

Objectives of Radio Network Planning, The Impact of User Environment, Cellular Network Planning Approaches, Starting Points for The Planning Procedure: Desired Grade of Service, System Specification, Equipment Specifications, Available Frequency Band, Service Area Topography, Traffic Distribution, Existing Infrastructure, Phases of The Planning Procedure, Radio Network Definition including Capacity planning, Starting Points and

Objectives, Frequency Reuse, Prediction of Offered Traffic, Capacity Planning Example, Propagation Analysis and Coverage Planning, Starting Points and Goals of Coverage Planning, Multipath Propagation: Path Loss, Hata Model, Walfish-Ikegami Model, Path Loss Corrections, Slow and Fast Fading, Connection Between Coverage and Quality of Service, Radio Link Power Budget: Antenna Feeder Loss, Antenna Gain, Application Example, Frequency Allocation, Starting Points and Objectives, Regular Frequency Reuse Patterns, Methods Applied in Frequency Planning: Interference Levels, Minimum Reuse Distances, Allocation of Frequencies, Adjacent Channel Interference Avoidance, Application Example: Simple Frequency Planning Method Using Regular Reuse Patterns, Advanced Frequency Planning Method Using Pairwise Interference Analysis, Cellular Network Planning Tools, Digital Maps, Capacity Planning in Radio Network Definition, Propagation Analysis and Coverage Planning: Hata Model and Walfish-Ikegami Model, Morphography, Antenna Height and Topography Corrections, Frequency Allocation, Route Calculations: Comparison of Predicted and Measured Data, Simulation of Calls Along Routes, Cellular Network Measurement: NMS/X, TIM and SAM of Nemo Technologies.

TE-5204 Error Control Coding

Block Codes and Their Implementation, Review of

Algebra for Coding; Rings: Integer Rings, Polynomials over Rings, Fields: The Structure of Finite Fields, Galois Fields; Construction of GF(gm), Linear Block Codes, Polynomial Description of Cyclic Codes, Quadratic Residue Codes, Golay Code, Hadamard Codes, Reed-Muller Codes, Shift-Register Encoders and Decoders of Cyclic Codes, Design of BCH Codes Based on Error Correction, Binary and Non-binary BCH Codes, Reed-Solomon (RS) Codes, Decoding: Berlekamp-Massey Algorithm, Performance of Block Codes, Probabilities of Decoding error and Decoding Failure, Bounds on the Minimum Distance, Soft Decision Decoding of Block Codes, Trellis Decoding, Error Control for Channels with Feedback, Pure ARQ Protocols: Error Detection, Noisy Feedback Channels, Type-I Hybrid - ARQ Protocols, Type-II Hybrid - ARQ Protocols, Convolutional Codes, Tree Codes and Trellis Codes, State Diagram, Free Distance, Polynomial Description of Convolutional Codes, Decoding; Maximum-Likelihood Sequence Estimation (MLSE): Viterbi Algorithm, Soft decision decoding, Maximum a posteriori (MAP) decoding -BCJR Algorithm, Sequential Decoding Algorithms: Stack Algorithm, Fano Algorithm, Punctured Convolutional Codes, Coded Modulation Schemes, Trellis Coded Modulation (TCM), Ungerboeck Codes, Multiple TCM, Lattices and Lattice Cosets, Trellis Codes on Lattice Cosets, TCM for Fading Channels; Code design Criteria, Performance

Evaluation, Block Coded Modulation (BCM), Multilevel Block Coding, Coding with Diversity: Space Time Coded Modulation (STCM), Decoding Algorithms and Performance Analysis, Equalization and Decoding: Soft Output Algorithms- SOVA, MAP, Concatenated Codes and Iterative Decoding, Block Codes, Block and Convolutional Codes, Recursive Systematic Convolutional Codes, Turbo Codes (Parallel Concatenated Convolutional Codes -PCCC), Serial CCC, Iterative Decoding-MAP Algorithms based on BCJR, Turbo Coded Modulation, Turbo Equalization, Performance Bounds in AWGN and Fading Channels, Advanced Coding Schemes, Turbo-TCM, Space Time Coding, Hybrid Coding Schemes, Adaptive Coding, Unequal Error Protection.

TE-5205 Radar Engineering

The Radar Range Equation. Radar ranging principles, frequencies, architecture, measurements, displays, and parameters. Radar range equation; radar waveforms; antenna patterns, types, and parameters. Noise in Receiving Systems and Detection Principles. Noise sources; statistical properties. Radar range equation; false alarm and detection probability; and pulse integration schemes. Radar cross section; stealth; fluctuating targets; stochastic models; detection of fluctuating targets. Propagation of Radio Waves in the Troposphere. The pattern propagation factor; interference (multipath,) and diffraction; refraction;

standard refractivity; sub-refractivity; super refractivity; trapping; propagation ducts; littoral propagation; modeling; attenuation. CW Radar, Doppler, and Receiver Architecture. Basic properties; CW and high PRF relationships; dynamic range, stability; isolation requirements, techniques, and devices; superheterodyne receivers; in-phase and quadrature receivers; signal spectrum; spectral broadening; matched filtering; Doppler filtering; Spectral modulation; CW ranging; and measurement accuracy. Radar Clutter. Surface and volumetric clutter; reflectivity; stochastic properties; global, local, and instantaneous distributions; spectral spread and correlation; sea, land, rain, chaff, birds, and urban clutter. Clutter Filtering Principles. Signal and clutter separation techniques; range and Doppler techniques; transmitter stability and filtering; pulse Doppler and MTI; MTD; blind speeds and blind ranges; staggered MTI; notch shaping; gains and losses. Performance measures for clutter. Improvement factor, limitation sources; stability noise sources; composite errors; types of MTI. Airborne Radar. Platform motion effects; iso-ranges and iso-Dopplers; antenna pattern effects; clutter; reflection point; altitude line. The role of medium and high PRF's in lookdown modes; the three PRF regimes; range and Doppler ambiguities; velocity search modes; high resolution Doppler sharpening and synthetic aperture ground mapping modes; pulse compression; stability and

mainbeam clutter. Radar Measurement Principles. Range over-sampling and interpolation. Angle measurement: beam interpolation, scanning radar, sequential lobbing, conical scan, and monopulse. EW vulnerability; error analysis; resolution, multiple targets, and glint; low elevation tracking; performance optimization methods. Advanced Topics. Electronically steered arrays; multifunction radars; active arrays; auto-calibration and compensation; high range resolution techniques: true time delays; instantaneous and synthetic wide band; adaptive cancellation techniques; digital beam forming. Multiple Target Tracking. Definition of basic terms. Track initiation: initiating new tracks; recursive and batch algorithms; sizing of gates for tracking; out of N processing. State estimation and filtering: least-squares filter and Kalman filter. Adaptive filtering and multiple model methods. Use of fastened suboptimal filters. Correlation and association: correlation tests and gates; association algorithms; probabilistic data association and multiple hypothesis algorithms.

TE-5206 Satellite Communication

This course is designed to provide a comprehensives understanding of satellite communications principles and related technologies involved. Starting from orbital mechanics related to spacecraft deployment, the course evolves through satellite link design, signal processing and access techniques, type of networks and finally drawing conclusion with performance and reliability of the system.

Introduction to Satellite Communications, Orbital Aspects of Earth Satellites, Satellite Link Design, Propagation on Satellite-Earth Paths and Its Influence on Link Design, Modulation, Multiplexing and Multiple Access Techniques in Satellite Communications, Satellite Networking, Spacecraft and Earth Station Technology, Types of Satellite Networks, Performance and Reliability of Satellite Communications.

TE-5207 Mobile Communications

Introduction to Cellular Mobile Radio Background and History, The Mobile Radio Environment, Diversity Schemes and Combining Techniques, Diversity Schemes and Combining Techniques, Cellular Traffic, The Analog Cellular Environment, Fading Channel Issues in Analog Systems, Existing Analog Cellular Radio Systems, The Digital Cellular Environment, Digital Modulation, Signal Processing and Data Formatting, Existing Digital Cellular Radio Systems, CDMA Systems, Capacity Analysis of Multiple Access Methods, IS-95 Standard for CDMA Cellular System, 3rd Generation CDMA Systems, 4th Generation Mobile Systems.

TE-5208 Advanced Wireless Communication

Review of probability theory, Essentials of (convex) optimization theory, Essentials of information theory, Wireless channel models and latest multiple

access technologies, Introduction to various channel models (namely frequency flat, frequency selective, Rayleigh and Ricean fading models), Introduction to CDMA and associated standards, Introduction to OFDM, Capacity of scalar wireless channels, Introduction to the notion of channel capacity, Capacity of time invariant channels, Capacity of time varying (or fading) channels, Capacity of vector (MISO, SIMO, MIMO) channels and spatial multiplexing, Capacity of MISO and SIMO channels for both time varying and time, invariant cases, Capacity of MIMO systems, V-BLAST and D-BLAST, STBC and STTC, Multiuser detection (MUD), Introduction to MUD, Linear decorrelator, MMSE MUD, Adaptive MUD, Application of convex optimization to wireless design, Minimizing PAPR in OFDM systems via convex optimization, Applications of convex optimization to MAC and flow control problems.

TE-5209 Network Security

Introduction to the Problem of Security, Introduction to Communication Network Security, Security services – The CIA triad, Network threats and attacks – Spoofing, Denial of Service (DoS), man-in-the-Middle, Theft of service, Eavesdropping, Impersonation, Spam, SPIT, Cryptography, Introduction to Cryptography, Cryptography terminology and definitions, Encryption notation, The cryptanalyst attack, Times for exhaustive key search, Early Cipher Systems, Introduction, Basic Cipher Systems, Substitution Ciphers, Transposition Ciphers, Important Historical Cipher Systems, Cryptanalysis and Cipher Security, Introduction, The strength of security systems (unconditionally secure and computationally secure), Entropy and Equivocation, Perfect Secrecy, Unicity Distance, The Date Encryption Standard: Introduction, History of the Data Encryption Standard, Basic Operation of the DES Algorithm, Using the DES Algorithm, Electronic Code Book Operation, Cipher Block Chaining Mode, Cipher Feedback Mode, Output Feedback Mode, Public Key Cryptography: The RSA Algorithm, Public Key Cryptography, Congruence's and Modular Arithmetic, Ciphers based on Exponential Techniques, The RSA Algorithm, Prime Number Generation, Encryption in Networks, Using Encryption in Computer Networks, Line-level Encryption, Data Link Layer Encipherment, End-toend Encryption, Node-by-Node Encryption, Security in the Internet, IPSecurity (IPSec), Secure Sockets Layer SSL/TLS, Pretty Good PrivacyPGP, Digital Signatures, Firewalls, Electronics Currency, Smart Cards. E-commerce.

TE-5210 Next Generation Networks

The main objective of this course is to provide students with in-depth understanding of Next Generation Network (NGNs) technologies. The course will cover history, overview, and how NGNs are shaping the current and future ICT landscape. Students will gain both a theoretical understanding and practical experience from laboratory work concerning the design and delivery of systems employing programmable networking technologies. The stress is put on networking APIs, SIP, IMS and converged service delivery platforms. There is a strong research and experimental aspect to this course. Students are expected to work with various NGNs technologies APIs to gain understanding in various architectural and programming aspects of NGNs and complex web and cloud-based technologies that combine various media and access network protocols.

TE-5211 Sensor Networks

Introduction to sensor networks, Sensor Networks Architecture and Protocol Stack, Factors influencing the design of sensor networks, Sensor Network Applications, Application Layer, Transport Layer Protocols, Routing Algorithms, Medium Access Control Protocols, Error Control Algorithms, Physical Layer Solutions, Localization and Target Detection Algorithms, Time Synchronization Algorithms, Sensor and Actor (Actuator) Networks, Coordination and Communication Problems, Underwater Sensor Networks and various Application scenarios.

TE-5212 Optical Fiber Communications

Fiber Optic Communication Systems. Introduction to analog and digital fiber optic systems including

terrestrial, undersea, CATV, gigabit Ethernet, RF antenna remoting, and plastic optical fiber data links. Optics and Lightwave Fundamentals. Ray theory, numerical aperture, diffraction, electromagnetic waves, polarization, dispersion, Fresnel reflection, optical waveguides, birefringence, phase velocity, group velocity. Optical Fibers. Step-index fibers, graded-index fibers, attenuation, optical modes, dispersion, nonlinearity, fiber types, bending loss. Optical Cables and Connectors. Types, construction, fusion splicing, connector types, insertion loss, return loss, connector care. Optical Transmitters. Introduction to semiconductor physics, FP, VCSEL, DFB lasers, direct modulation, linearity, RIN noise, dynamic range, temperature dependence, bias control, drive circuitry, threshold current, slope efficiency, chirp. Optical Modulators. Mach-Zehnder interferometer, Electro-optic modulator, electro-absorption modulator, linearity, bias control, insertion loss, polarization. Optical Receivers. Quantum properties of light, PN, PIN, APD, design, thermal noise, shot noise, sensitivity characteristics, BER, front end electronics, bandwidth limitations, linearity, guantum efficiency. Optical Amplifiers. EDFA, Raman, semiconductor, gain, noise, dynamics, power amplifier, pre-amplifier, line amplifier. Passive Fiber Optic Components. Couplers, isolators, circulators, WDM filters, Add-Drop multiplexers, attenuators. Component

Specification Sheets. Interpreting optical component spec. sheets - what makes the best design component for a given application. FIBER OPTIC SYSTEMS: Design of Fiber Optic Links. Systems design issues that are addressed include: loss-limited and dispersion limited systems, power budget, rise-time budget and sources of power penalty. Network Properties. Introduction to fiber optic network properties, specifying and characterizing optical analog and digital networks. Optical Impairments. Introduction to optical impairments for digital and analog links. Dispersion, loss, non-linearity, optical amplifier noise, laser clipping to SBS (also distortions), back reflection, return loss, CSO CTB, noise. Compensation Techniques. As data rates of fiber optical systems go beyond a few Gbits/sec, dispersion management is essential for the design of long-haul systems. The following dispersion management schemes are discussed: pre-compensation, post-compensation, dispersion compensating fiber, optical filters and fiber Bragg gratings. WDM Systems. The properties, components and issues involved with using a WDM system are discussed. Examples of modern WDM systems are provided. Digital Fiber Optic Link Examples: Worked examples are provided for modern systems and the methodology for designing a fiber communication system is explained. Terrestrial systems, undersea systems, Gigabit ethernet, and plastic optical fiber links. Analog Fiber Optic Link Examples: Worked examples are provided for modern systems and the methodology for designing a fiber communication system is explained. Cable television, RF antenna remoting, RF phased array systems. Test and Measurement. Power, wavelength, spectral analysis, BERT jitter, OTDR, PMD, dispersion, SBS, Noise-Power-Ratio (NPR), intensity noise.

TE-5213 Advanced Computer Networks

A high-level top-down view of computer networking, Applications of networking, Building a network. Applications, requirements---Connectivity, Resource Sharing, Support for Common Services, Network Architecture, Network Software, Performance, Direct Link Networks, Physically connecting Hosts, Hardware building blocks, Encoding, Framing, Error Detection, Reliable Transmission, Ethernet, Token Rings, Wireless, Network Adapters, Packet Switching, Not all nodes are directly connected, Switching and Forwarding, Bridges and LAN Switches, Cell Switching, Implementation and Performance, Internetworking, There is more than one network, Simple Internetworking, Internet Protocol, Routing, Global Internet, Multicast, MPLS, End-to-End Protocols, Getting processes to communicate, UDP, TCP, RPC, Congestion Control and Resource Allocation, Allocating Resources, Issues in Resource Allocation, Queuing Disciplines, TCP Congestion Control, Congestion Avoidance Mechanism, Quality

of Service, IntServ/ DiffServ, End to End Data, Presentation Formatting, Data Compression, Network Security, Securing the Data, Cryptographic algorithms, Security Mechanisms, Example Systems, Firewalls, Applications, Applications need their own protocol, Name Service, Traditional Applications, Multimedia Applications, Overlay Networks, Network Monitoring and Management, Network need to be monitored and managed.

TE-5214 Advanced Image Processing

Introduction to Digital Image Processing, Motivation for taking the Digital Image Processing course. Image enhancement in the Spatial Domain. Histogram Processing (Equalization, Matching, local enhancements using histogram statistics), Spatial filters (smoothing, sharpening), Enhancement Using Arithmetic/Logic Operations, Image enhancement in the Frequency domain, Frequency domain basics and relationship with spatial domain's image characteristics, Frequency domain filters design (smoothing, sharpening and homomorphic), filters implementation in MATLAB, Color image processing, color transformation models, color segmentation, using all the digital image processing techniques studied till this point with the perspective of color images, Digital image compression, Coding Redundancy, Interpixel Redundancy, Psychovisual Redundancy, Image Compression models, Various image and video compression standards. This course will have in

depth exercises based on various course concepts in MATLAB.

TE-5215 Real Time DSP

The essential features of a DSP system. Outline applications of DSP. The DSP kernel equation - SOP (the sum of products) as a key operation in filtering, spectral analysis and controller algorithms etc. Impact of SOP implementation on processor architecture and instruction set. Examples of DSP processor architecture with emphasis on the ADSP2181. Binary arithmetic: Review of 2s complement arithmetic, Signed and unsigned integer binary multiplication. Fractional binary formats and binary arithmetic using fractional formats. DSP processor hardware and software: The Harvard versus the Von-Neuman architecture, the ADSP2181 30nS 16 bit fixed point programmable digital signal processor, Architecture and Instruction set. Memory organization: Memory organization on the ADSP-2181. Linker description file. Interfacing and memory configuration examples, Data address generation. Circular buffers. Wave-tables, waveform and audio effects generation: Wave-form generation by look up table (wave-table), Delay and echo generation using circular buffers. Discrete signal processing fundamentals: Classification of signals - the impulse and pulse, and continuous signals, Ideal sampling, the spectrum of sampled signals, Manipulation of sequences, Sequences, periodicity, digital frequency, the Nyquist rate, the

impact of the Nyquist rate on DSP algorithms and hence the processor instruction set and architecture, Aliasing, Minimization of aliasing through low pass filtering and oversampling, the characteristics of the ideal anti-alias filter (input signal dependency), Comparison of Bessel, Butterworth etc. analog filters as antialias filters.

Antialias filter selection, Over-sampling and decimation (digital filtering) as a means of relieving anti-alias filter specifications, the reconstruction process - information recovery from sampled signals using sample and hold, the reconstruction filter. sin(x)/x compensation. Spectral Estimation using DFT and FFT: Review of the meaning of Fourier analysis, the Fourier series, the Fourier transform, the discrete Fourier transform DFT - twiddle factors. the Fast Fourier transform FFT, the need for windowing, Spectral leakage, smoothing and ripple, Comparison and choice of window function, Use of PCSDP for DFT and FFT estimation, Implementation of the DFT and/or FFT on the ADSP 2181 processor. LTI systems and convolution: Properties of linear time invariant (LTI) systems. Stability, causality, linearity, time invariance, Frequency response and transfer functions - brief review, the unit sample (impulse) response. Linear convolution. The z transform: Definition. The ROC. Application to right sided discrete time sequences, Closed form and tables. The difference equation and the z shift operator, Digital oscillator based on the recursive

solution of the z transform, Transfer functions, poles and zeros, stability and the unit circle. Difference equations: Discrete approximations to integration and differentiation, Difference equations, Block diagram representation of difference equations the unit delay, gain, summation. FIR digital filters : The FIR filter as an application of convolution, the filter MASK specifications, pass band and stop band tolerances (ripple), transition bandwidth, Nonrecursive digital filters: Direct form structures of FIR filters, Applications and advantages of FIR filters, the need for truncating and windowing impulse response coefficients, windowing. Window types e.g. rectangular, Blackman, Hamming, Hanning etc. Window functions with adjustable parameters e.g. the Kaiser window, Excel based window generation, FIR filter design using Fourier series, Design tradeoffs between MASK specs and filter tap number and window type, Design of N tap filter using Kaiser window or Parks-McClellan methods, Implementation of FIR filters on the ADSP2181 processor. Recursive (IIR) Digital Filters: Digital filter development from the analog domain description, Review of analog filters and the s domain, Review of pole positions, frequency and phase responses, Review of analog filter design based upon low pass prototype selection and frequency transformations, Butterworth, Chebyshev I & II, Cauer and Bessel prototype low pass filter approximations, the concept of s plane to z plane mapping. Examples of mappings, Digital filter design from analog transfer functions based on the Bilinear transformation, Frequency pre-warping, the z plane, pole positions, frequency and phase responses, use of PCDSP for filter design and performance analysis, effects of rounding / truncation of filter coefficients on pole positions – pole sensitivity and its impact on the filter structure, choice of filter structure, scaling for filter implementation on a fixed-point arithmetic processor. Saturation arithmetic.

TE-5216 Microwave Engineering

Microwave frequencies, Standard Frequency bands, Behaviour of circuits at Conventional and microwave frequencies, Microwave application, Review of Maxwell's equations. Overview of guided waves; TE, TM and TEM modes, circular wave guide, Choice of the type of waveguide dimensions, waveguide problems. Microwave Components & Devices : Scattering matrix and its Properties, coupling probes, coupling loops, windows, Waveguide tuners, Termination, E-plane Tee, Hplane Tee, Magic Tee, Phase-Shifter, attenuators, Directional coupler, Gunn diode, Microwave transistor MASER, Resonator and circulators. Microwave Genereators : Transit-time effect, Limitations of conventional tubes, Two-cavity and multi-cavity Klystrons, Reflex Klystron, TWT and Magnetrons. Microwave Antennas : Directional characteristics of antennas. Dipole, folded dipole and Yagi antenna, Broadband, Antenna arrays, Horn antennas. Parabolic antenna, Lens antenna. Microwave Measurements : Power measurement; Calorimeter method, Bolometer bridge method, thermocouples, Impedance measurement, Measurement of frequency and wavelength, Measurement of unknown loads, Measurement of reflection coefficient, VSWR and Noise, Microwave test bench.

TE-5217 Advanced Engineering Electromagnetics

Introduction, Maxwell's equations, Constitutive relations, Boundary conditions, Power and energy, Time-harmonic electromagnetic fields, Solution to the time-harmonic wave equation in Cartesian coordinate system, Transverse electromagnetic waves, Uniform plane waves in lossless media at oblique angles, Transverse electromagnetic waves in lossy media, Polarization of TEM waves, E polarized UPWs obliquely incident on a lossless half space, H polarized UPWs obliquely incident on a lossless half space, Duality, Brewster angle of incidence, critical angle of incidence, lossy media, UPW normally incident on a dielectric-conductor interface, UPW scattering by a single slab layer, UPW scattering by multiple slab layers, Low reflection, multi-layer slab design, Applications of multi-layer UPW theory, TE and TM modes in rectangular waveguides, Equivalent TL model of waveguides, Rectangular resonant cavities, Solutions to characteristic equation for a grounded dielectric slab waveguide.

TE-5218 Mobile Ad-hoc Networks

Introduction to Mobile Ad-Hoc Networks. Ad-Hoc networks topologies, Physical and MAC layer specifications and design considerations for MANETs, Physical and MAC layer specifications and design considerations for IEEE 802.11 and IEEE 802.16 family of standards, Mobility in Ad-Hoc networks, Introduction to Mobile IPv4 and IPv6, Fast Mobile IP, Hierarchal Mobile IP, Routing Layer for MANETS - design and performance considerations, Routing protocols for MANETs (Proactive, Reactive, Hybrid, Hierarchal and Location based routing protocols for MANETs), Quality of Service provisions in the IEEE 802.11 and IEEE 802.16 family of standards and relevance to MANET operation. In depth analysis of the various course topics in network simulators e.g. OPNET/NS2/OMNet++.

TE-5220 Advanced GSM Architecture

Introduction of GSM, GSM services, Bearer services in GSM, Teleservices in GSM, GSM Standards, ETSI and the Special Mobile Group, GSM Phase 2+, 3GSM, 3GPP and UMTS, GSM system architecture, GSM architecture, GSM addressing, IMSI, MSISDN, TMSI, MSRN, SPC, LAI, GCI, Location areas and identity numbers, GSM Air Interface, Basic of speech coding, GSM radio propagation and impairments, GSM cell planning, GSM subsystems, Subscriber Identity Module (SIM), Security

procedures and algorisms, Roaming and Call Routing, Routing in GSM PLMNs, Location registration, Base Station Subsystem (BSS), Base Transceiver Station (BTS) part of BSS, Base Station Controller (BSC) part of BSS, Transcoding Rate and Adaptation Unit (TRAU), Network Switching Subsystem (NSS), NSS Components, HLR/AuC, EIR, NSS Subsystems and SS7, Mobile Services Switching Center (MSC) part of NSS, MSC/VLR, SS7 IN GSM, Call processing and information access, SS7 network architecture, SSP, STP and SCP, SS7 routing, SS7 links, SS7 protocols, Message Transfer Part (MTP) 1-3, SCCP, TCAP, MAP, AIR INTERFACE (MS-BSS) OF GSM, ABIS INTERFACE (BSS-BSC), A-INTERFACE (BSC-MSC), Signaling over A-Interface, The Base Station Subsystem Application Part, SS7, SCCP/User part, Advanced features of GSM: AMR, Comparison of AMR and other GSM, coding schemes, EDGE, 8PSK vs. GMSK, EDGE Modulation and Coding Schemes (MCS), GAIT, AMR, Comparison of AMR and other GSM, Coding schemes, EDGE, 8PSK vs. GMSK, GSM/ANSI-136 Integration Team (or GAIT), and Location Management.

Department of Computer Science & Information Technology

Introduction

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.

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Chairperson

Dr. Wajeeha Khalil

Ph.D. (Austria)

Assistant Professors

Dr. M. Kamran Ghani	Ph.D. UK (sabbatical leave)
/Ir. Izhar Ullah	(Ph.D. Study Leave)
Dr. Syed Adeel Ali Shah	Ph.D. (Malaysia)
/Ir. Laeeq Ahmed	(Ph.D. Study Leave)
ingr. Sadeeq Jan	(Ph.D. Study Leave)
/Ir. Ismat Ullah Khan	M.Sc. (CS), Pak
)r. Iftikhar Ahmed	Ph.D, Germany

Lecturers

Ph.D. (The Netherlands)
(Ph.D. Study Leave)
MS (CS), Pak
MS (CS), Pak
MS (CS), Pak
MS (CS), UK
MS (IT), Pak
MIT (Pak)
MS (CS), Pak
(Ph.D. Study Leave)

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

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, Selfreference 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 bruteforce, greedy, divide-and-conquer, backtracking, branchand-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 noncomputability, NP-completeness, Search Techniques, Randomized Algorithms, Heuristic and Approximation Algorithms.

CS-5502 Advanced Operating System (Core Course) (3)

This course will cover: Introduction to OS, Characterization of Modern Operating Systems file systems memory management techniques, Process scheduling and resource management, Process Management Interrupt Handling, Threads System Models, Architecture Models, Distributed System, Characteristics, Design Issues, Distributed Operating Systems, Memory Management and Techniques, No abstraction Model, Abstraction Model, Virtual Memory management, Virtual Memory, Paging, Distributed File System, File Management, Inter process Communication, Message Passing, Issues of Security in Distributed Systems (Partial coverage), Concurrency Control in Distributed Systems, Problems of coordination and agreement in Distributed Systems, Replication -Advantages and requirements, Fault-tolerant services, Mobile and Ubiquitous Computing, Advances Topics.

CS-5503 Advanced Computer Architecture (Core Course) (3)

This course will cover: Introductory concepts of Computer Architecture, Computer Architecture, Organization, ISA, RISC and CISC, Computational Models,

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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 execution, Types and level of parallelism, concurrent execution models, multitasking, multi-programming, multi-processing, Flyn's Taxonomy (SISD, SIMD, MISD and MIMD), Pipelining and Hazards, Pipelining basics and its characteristics, pipelining hazards (Structural hazards, Data hazards, control hazards), solution of such hazards, advantages/ disadvantages of pipelining, Instruction Level Parallelism (ILP), ILP basics, challenges, data dependence and hazards, name dependences, instruction dependence example, control dependences, loop level parallelism, static and dynamic scheduling. Scoreboard and tomasolu algorithm, Superscalar and VLIW processors, Memory Hierarchy design, Cache memory, strategies, operation, performance measures, virtual memory, Input Output (I/O), I/O subsystems, major components of an I/O subsystems, interface, peripherals, memory mapped I/O vs isolated I/O, serial and parallel transfers, Programmed I/O, Interrupt-driver I/O, DMA, I/O buses.

CS-5504 Research Methodology (Core Course) (2)

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 data clearly and effectively in both tabular and graphical formats, SPSS -To introduce one of the popular and well-established statistical tool for scientific research in a variety of disciplines, Planning and Presenting a Talk - To help prepare and present a talk in a hand on interactive session. Paper Publication - It explore the publication process towards a good paper, reviewing process and general ethics for writing both conference and journal publications, Thesis Writing - It emphasises on structuring thesis, gaining understanding of assessor's perspective, and practical tips on managing your time, Preparing for Viva - To get practical tips on effective preparation and performing well in viva.

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)

This course will cover: What Is Software Quality: Quality Assurance, Quality Engineering, SOFTWARE TESTING: Testing: Concepts, Issues, and Techniques, Test Activities, Management, and Automation, Coverage and Usage Testing Based on Checklists and Partitions, Input Domain Partitioning and Boundary Testing, Coverage and Usage Testing Based on Finite-State Machines and Markov Chains, Control Flow, Data Dependency, and Interaction Testing, Testing Techniques: Adaptation, Specialization, and Integration, QUALITY ASSURANCE BEYOND TESTING: Defect Prevention and Process Improvement, Software Inspection, Formal Verification, Fault Tolerance and Failure Containment, Comparing Quality Assurance Techniques and Activities. QUANTIFIABLE QUALITY IMPROVEMENT: Feedback Loop and Activities for Quantifiable Quality Improvement, Quality Models and Measurements, Defect Classification and Analysis, Risk Identification for Quantifiable Quality Improvement, Software Reliability Engineering, Use of

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automated testing tools, Testing of a wide variety of software, Application of a wide variety of testing techniques, Inspecting of software in teams; comparison and analysis of results.

CS-5533 Software Project Management (3)

This course will cover: Executive Overview of Project Management, Bounding Project Scope, Project Classification Frameworks, Creating the Project Charter, Leading and Managing the Project Team, Work Breakdown and Organizational Structures, Task Planning, Labor-Driven Activities, Project Network Modeling, Project Management Software, Resource Leveling and Project Budget, Project Control, Project Quality Management, Contracting and Sub-contracting, Risk Management, Evaluating, Directing, and Closing Out a Project, Business Ethics

CS-5534 Software Measurement and Metrics (3)

This course will cover: Measurement theory (overview of software metrics, basics of measurement theory, goalbased 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)

Ontology Engineering: Principles, Methods, Tools, and Languages, Using Ontologies in Software Engineering, Development of Ontologies for SWEBOK (Software Engineering Body of Knowledge): Issues and Techniques, Some Ontologies for Software Development: Ontologies for Requirements, Design, Maintenance, Measurements, Use of Ontologies in Domain Oriented Software Development Environments, Comparative Study of Semantics Coverage in Ontologies as per SWEBOK, Alignment of Different Available Ontologies.

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, Metamodeling, 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)

This course will cover: Faults, Failures, and their Costs, Oracles and Principles, Model Based Testing, Models, Finite State Machines, Decision Tables & Markov Chains, Design and Unit testing, Design Metrics, Static Analysis, Domain, Coverage, Integration Testing, System Testing 1: Functional, Negative, Scenario, Mutation, Measuring and Monitoring the Test Process, Security & Reliability Testing, Regression, Performance, and Web Application Testing, Test Planning, Automated Software Testing, Search Based Software Testing.

CS-5550 Computer Security (3)

This course will cover: Introduction to secure computing. Introduction to Computer Security, Basic Components, threat classes Policies and Mechanism, Trust assumptions in modern computing systems, Types of mechanism, operational Issues, Human issues, Identification and Authentication, Why Computer systems are not secure, Internal and External Security, The System Boundary and the Security Perimeter, Automated tools for computer system related attacks, Pieces of security puzzle. Cryptology, Classical cryptography, Number theory, public key cryptography, Software security, Database security, File security, Program security, Malicious software, Operating System security, Application security, Secure programming, Authentication, Passwords and their management, Token devices, Synchronous and Asynchronous devices, Time based synchronous devices, Cryptographic keys, Memory and Smart cards, pin protected cards, one time passwords, Biometrics etc., Windows Password Security, Unix Password Security, Types of Attacks on Passwords,

Password hardening techniques. Access Control Systems and Methodology, Access control fundamentals, Biometrics, Discretionary access control, Access control lists (ACLs) and capabilities, implementation of access control, confinement and revocation, Mandatory access control, MAC models and their implementation, Rolebased Access Control (RBAC), Multilevel Security, Access Criteria , Single Sign on Technologies , Kerberos , SESAME, Thin Clients, Scripts, Directory Services, Centralized Access Control Methodologies, RADIUS, TACASC, TACACS+ , Diameter , Technical Access Control Mechanisms, Unauthorized disclosure of information (Object reuse, TEMPEST etc). Computer Security Attacks, Understanding Covert Channel Attacks, Trapdoors, Timing Attacks, Buffer Overflow attacks, Data Validation attacks, Trojan Horses, Viruses and Worms, Computer Security Evaluation Standards, Assurance Rating, TCSEC(Trusted Computer Security Evaluation Criteria), Rainbow Series, ITSEC(Information Technology Security Evaluation Criteria), CC(Common Criteria), Certification and Accreditation, Software protection, Copy protection techniques, Watermarking, Anti-debugging, Obfuscation. Malicious software. Types of malware (Trojans, Worms, Viruses, Spyware), Scanning and detection techniques.

CS-5551 Advanced Network Security (3)

This course will cover: Introduction to Networking and Computer Security, Security aspects of Networking Technologies (LAN, MAN, WAN), Contemporary and Serious network threats (hacking, malware), Firewalls (implementation, security), Introduction to Cryptography, Cryptology, classical cryptosystems, Public key cryptosystems, The Threat Environment: Attackers and their Attacks. Basic Security Terminology. Employee and ExEmployee threats, Traditional External Attacks, The Criminal Era, Cyberware and Cyberterror, A Constantly Changing Threat Environment. Networking attacks and their Traceback, TCP Handshake, IP Spoofing & SYN Flood, Distributed DoS (DDoS) Attacks, Prevention and Detection, Trace back, Input Debugging, ICMP Trace back. Botnets. Elements of Cryptography Introduction, Cryptographic Systems, VPN, SSL/TLS, WAN Security, Ethernet Security, Wireless Security. IP Security, IPSec architecture & concepts, IPSec authentication header, IPSec encapsulating security payload, Key Management -Concepts, Manual Exchange, Internet Key Exchange, IPSec Strengths & Weaknesses, Implementation of IPSec, Access Controls, Org and Human Controls, Physical Access and Security, Biometric Authentication, Cryptographic Authentication, Authorization, Central Authentication, Directory Servers, Full Identification Management. Intrusion Detection Systems, Types of IDS (network, host), Intrusion Detection: Theory (signature, anomaly, deep-packet inspection), Intrusion Detection: Implementation, Case Study: Snort, Intrusion Prevention System, Differences between IDS and IPS, Intrusion Prevention: Theory and Practice, Web Application Security, General Application Security Issues, WWW and Ecommerce Security, Email Security, User Application Security.

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 applications, Security of mobile code

CS-5554 Applied Cryptography (3)

This course will cover: Classical cipher systems-Terminology, Cryptography and Cryptanalysis, Aspects of Security, Transposition ciphers, Substitution ciphers, Caesar, Vigenere, Vernam, Playfair, Rotor machines, enigma machine, analysis of mono-alphabetic, polyalphabetic substitution ciphers, Index of Coincidence, MIC. Mathematics of Cryptology, Number theory, Abstract algebra (groups, rings, fields), Secret-key cryptography-Block ciphers (DES, AES), Stream ciphers (LFSR-based stream ciphers, RC4), Modes of operation (ECB, CBC, CFB, OFB). Block Ciphers Shannon's Theory, Perfect Secrecy, Entropy, One time Pad, Block ciphers, building blocks of block ciphers. Block cipher systems. DES, Design Principles and Modes of Operation, Evaluation criteria for AES, AES Cipher, Correlations and Walsh Transforms, Cryptographic Criteria: Propagation Characteristics, Nonlinearity and Resiliency, Generalization to S-Boxes. Pseudo-Random-Sequence Generators and Stream Ciphers-Linear Feedback Shift Registers, BerlekampMasssey algorithm, Nonlinear Filtering Functions, Nonlinear Combiners, Design and Analysis of Stream Ciphers, Stream Ciphers Using LFSRs, Non-Linear- Feedback Shift Registers, Cascading Multiple Stream Ciphers, Clock controlled registers, Cryptographic properties of Boolean functions. Public key Cryptography-Introduction to Public-key Cryptography, RSA algorithm, The Rabin Cryptosystem, Discrete Logarithm Algorithms in Practice, Probabilistic public key encryption, The Merkle-Hellman and Chor-Rivest knapsack cryptosystems, Elliptic curve cryptography, Digital Signature and Authentications Threats, Authentication, Examples of signatures, Handshaking, RSA Signature system, Elgamal signature scheme and DSS, guadratic residue signature scheme, ECDSA. Message Authentication Codes. Hash Functions. Security of Hash Functions, MD5 message Digest algorithm, Secure Hash Algorithm – RIPEMD – HMAC. (2 weeks). Integrity and authentication-Hash functions (MD5, SHA-1), Message-authentication codes. Digital signatures.

CS-5555 Ethical Hacking (3)

This course will cover: Concepts of ethical hacking, Terminology, types of hacking technologies, stages of ethical hacking, classification of hackers, vulnerability research and implications of hacking. Footprinting and

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social engineering -footprinting concepts, information gathering methodology, DNS enumeration Whois ARIN Lookups, social engineering concepts, attacks, phishing attacks, online scams). Scanning and Enumeration-Port Scanning, Network Scanning, Vulnerability Scanning ,Ping Sweep techniques, Understanding Nmap Command switches, Using SYN, Stealth, XMAS, NULL and FIN, Scans Understanding Banner Grabbing and OS Fingerprinting ,Using proxy servers to launch an attack, Understanding IP spoofing and HTTP tunneling. System Hacking-Password cracking techniques, Redirecting the SMB Logon to Attacker, Redirecting, SMB, NetBIOS DoS attacks, Password cracking countermeasures, Understanding, Keyloggers and other spyware technologies, Escalating Privileges, Buffer Overflow Attacks, Understanding Rootkits, Understand How to break into a system. Sniffing-Understanding protocols susceptible to sniffing, Active and passive sniffing, ARP poisoning, Understanding MAC flooding, DNS Spoofing, Sniffing countermeasures. Web Application vulnerabilities- Web-Based Password Cracking Techniques. Wireless Hacking-Overview of WEP and WPA cracking techniques. Wireless sniffers and locating SSIDs, MAC Spoofing , Rogue Access Points , Wireless Hacking Techniques. Methods used to security Wireless Networks-Penetration Testing Methodologies, Security Assessments, Overview of Penetration Testing Methodologies, List of Penetration Testing Steps, Overview of Pen-Test Legal Framework. Automated Penetration Testing Tools

CS-5556 Software Engineering & 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)

This course will cover: Computer Crime, legislation, enforcement, Computer Investigation Process, Initial Response Procedure, Computer Security Incident Response Teams, Computer Forensic Labs, Understanding File Systems and Hard Disks, Understanding Digital Media Devices, Windows, Linux and Macintosh Boot Processes, Windows Forensics, Linux Forensics, Data Acquisition and Duplication, Computer Forensic Tools (software, hardware, EnCase), Recovering Deleted Files and Deleted partitions, Image Files Forensics, Professional Ethics and codes of conduct, Advanced topics (Steganography, Application Password Crackers, Network Forensics and Investigating Logs)

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-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)

This course will cover: Introduction to Distributed Computing, Peer-to-Peer Computing, Client/Server Computing, Utility Computing, Cluster Computing, High Performance Computing, Grid Computing, Cloud Computing, Autonomous Computing, Ubiquitous Computing, Pervasive Computing, Mobile Computing,

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Green Computing, Characteristics, Architecture, Application and Examples from each Paradigms, Comparison of Paradigms and Scenarios for best option.

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)

This course will cover: Background, Distributed Systems, Webservices, Utility Computing, Service Oriented Architectures, Grid technology (background), Concepts, Architectures, Services, Protocols, The Open Grid Forum, International Grid Trust Federation, Computing Platforms, Grid middleware and tools, Legion, Globus, Unicore, Grid Middleware: Globus, Security, Information services, Resource management. Data transfer. Grid Applications, Examples: Physics, Visualization, Bioinformatics etc, Grid Infrastructures, Examples of large scale projects, EU GridLab, EU DataGrid, TeraGrid, E-infrastructures, Programming Languages and Environments, Programming the Grid, Legacy code, Resource management and scheduling: Characterization of resource management problems based on job requirements, characteristics, and availability of resources, Algorithms, tools and sample resource management systems, Sun Grid Engine , Condor-G, Nimrod-G, 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-5590 Advance Computer Networks (3)

This course will cover: Review of basic concepts: The OSI Model, packet and circuit switching, network topology, ISDN. The TCP/IP protocol stack: IP, ARP, TCP and UDP, DNS, ICMP, Internet Addressing, Routing, IP Multicast, RSVP, Next Generation IP – Ipng, Wireless: Radio basics, Satellite Systems, WAP, current trends, Issues with wireless over TCP. Congestion Control: Control vs. Avoidance. Algorithms, Congestion in the Internet. Mobile IP, Voice over IP (VoIP), VPNs, Network Security. Management: Quality of Service (QoS), network vs. distributed systems management Protocols, web-based management.

CS-5591 Topics in Computer Networking (3)

This course will cover: advanced introduction and research perspectives in the areas of switch/router architectures, scheduling for best-effort and guaranteed services, QoS mechanisms and architectures, web protocols and applications, network interface design, optical networking, and network economics. The course also includes a research project in computer networking involving literature survey, critical analysis, and finally, an original and novel research contribution. Overview of packet switching networks and devices. Fundamentals of Internet Protocol (IP) networking. Route lookup algorithms. Router architecture and performance. Detailed operation of Internet routing protocols such as Open Shortest Path First (OSPF) and Border Gateway Protocol (BGP). Integrated and differentiated network service models. Traffic Engineering (TE) concepts and mechanisms including label assignment, label distribution, and constraint-based routing algorithms. Multi-protocol label switching and its generalization. Quality of service mechanisms for multimedia and realtime communications. TE-based routing and signaling protocols. Fundamentals of per-flow and aggregate scheduling algorithms. Application-level and networklevel signaling protocols for data, voice, and video communications. Resource signaling and resource reservation protocols. Worst-case analysis for multimedia networking.

CS-5592 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 middleware 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.

CS-5596 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, nary 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,

CS-5611 Multimedia Information Systems (3)

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 & Movement, Sound, Language & Thought, Interactivity, Learning

CS-5612 Distributed Database systems (3)

This course will cover: Distributed Databases Basics, Distributed Databases: What and Why?; the Distributed Database Management Systems, The Distributed Transparency – the Reference Architecture for Distributed Databases, Data Fragmentation, Distributed, Transparency for Read-Only and Applications, Distributed Database Access Primitives, Integrity Constraints, Distributed Database Design, Framework for Distributed Database Design, the Database Fragmentation Design, Allocation of Fragments. Translation of Global Queries to Fragment Queries, The Equivalence Transformation for Queries, Transforming Global Queries into Fragment Queries, Distributed Grouping and Aggregate Function Evaluation, Parametric Queries, Optimization Of Access Strategies, Framework for Query Optimization, Join Queries - - use of Semi-Join Programs for Join Queries, the SDD-I Algorithm, the AHY approach, Use of Join as Query Processing Tactic; General Queries - - Effect of Commuting Joins and Unions, Methods for the Optimization of General Queries. The Management of Distributed Transactions, The Framework for Transaction Management; Atomicity of Distributed Transactions; Concurrency Control for Distributed Transactions; Architectural Aspects of Distributed Transactions, Concurrency Control in distributed databases, Foundations of Distributed Concurrency Control; Distributed Deadlocks; Concurrency Control based on Timestamps; Optimistic Methods for Concurrency Control. Distributed Database Administration, Catalog Management in Distributed Databases, Authorization and Protection. The System R *, The Architecture of System R*: Compilation, Execution and Recompilation of Queries; Protocols for Data Definition and Authorization in R*, Transaction and Terminal Management.

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

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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-5630 Machine Learning and Neural Networks (3)

This course will cover: Machine learning, Neural Networks, Density estimation, Supervised learning, Linear and logistic regression, Generative classification models, Multi-layer neural networks, Support vector machines, Multilayer Neural Network, Unsupervised learning, Bayesian belief networks (BBNs), Learning parameters and structure of BBNs, Expectation maximization, Clustering, Dimensionality reduction/feature selection, Feature filtering, Wrapper methods, PCA, Ensemble methods (mixtures of experts, bagging and boosting). Reinforcement Learning.

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, Visualizationoriented DSS, Business intelligence and data warehousing, Web-based & Distributed DSS Architectures, Spatial DSS.

CS-5632 Knowledge Based System (3)

This course will cover: Expert Systems - Introduction, Definition, characteristics, Typical Applications, Example Systems, Components of Expert Systems (Architecture), Knowledge Base, Knowledge Representation, Meta-Knowledge, Inference, Engine, Search Techniques, Reasoning With Uncertainty, User Interface, User Dialog, Explanation, Tutoring, Tools and Environments for Expert System Development, Building an Expert System, Problem Selection, Development Methodology, Knowledge Acquisition, Pitfalls, Evaluation an Expert System, Test Cases, Refinement, Performance, Intelligent Database Systems, Data Models, Active Database Systems, Derivable Attribute Values, Intelligent Information Systems, Blackboard Architecture, Wrapper Architecture, Dependent Agent Architecture, Any additional Topics.

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: Partof-speech tagging (Brill, HMM), Efficient representations for linguistic resources (lexica, grammars,...): tries and finite-state automata, Syntactic level, Grammars (e.g. Formal/Chomsky hierarchy, dcgs, systemic, case, unification, stochastic), Parsing (top-down, bottom-up, chart (Earley algorithm), CYK algorithm), Automated estimation of probabilistic model parameters (insideoutside 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)

This course will cover: Introduction to HCI, Paradigms of Interaction, Interaction Design Basics, HCI in software Process/ Usability Engineering, Design Rules, Evaluation Techniques, Hierarchical Task Analysis, Universal Design/User Support, Cognitive, Communication & Collaboration Models, Groupware and CSCW, Additional Topics, Survey Methods, User Experience, Scenario Based Development Framework, Digital Personas, Story-board, Usability Comparison of Websites, Adaptation of HCI in Conventional Software Life Cycle, HCI and Ubiquitous Computing, Case Studies.

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)

This course will cover: Review of classical control analysis methods. Nyquist stability criterion. Classical design using frequency domain methods, phase lead and lag controllers, PID controllers. Relay auto tuning. Introduction to state space methods. State space models, state transformations, solution of the state equations. Controllability and observability. Design using state feedback. LQR design, pole placement, use of observers. Introduction to robotics. Transducers, actuators and robot control.

CS-5510 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 programing techniques, Revised Simplex Algorithm, Dimensional

Dantzig-Wolfe Decomposi-Cutting Stock Problem. tion 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, multiobjective 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-5511 E-Learning Design and Development (3)

This course will cover: Historical background and current trends in E-learning. Concepts and foundations of best practices for successful teaching online. E-learning theory, principles, learning management systems, and web-based technology tools. Engaged Learning in an Online Environment: Advantages of Online Education, Current Research, Myths and Constraints of Online Teaching and Learning, Methods and Measures to Retain Students Enrolled in Online Education, Learning Theory in the Online Classroom, Trends in E-learning, Introduction to Asynchronous Discussion, Hands on Social Bookmarking, Critical Reflection, Building Learning Communities: Adapting Classroom Based Activities to Cyberspace, Choosing an Effective Communication Tool, Introduction to Moodle (Open Source CMS), Exploration of Blogs and Blogging, Critical Reflection, Activities to Engage Online Learners: Icebreakers, Creating and Facilitating a Discussion Forum, Questioning Strategies, Cooperative Learning, Sharing Web 2.0 Technologies, Critical Reflection, Measuring Online Learning: Student Performance, Course Evaluation, Program Evaluation, Survey and Quiz Technology, Creating Assignments and Assessments, Ethical Use of Digital Resources, Understanding Copyright and Fair Use, Exploration of Podcasting, Information Fluency: Evaluation of Websites, Power Searching Techniques, Critical Reflection, Power Searching: Theory into Practice; Research Project, Self-Paced and Self-Directed Learning, Creating a Personal Search Engine, Peer Feedback Exercise, Critical Reflection, Additional Topics.

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)

This course will cover: Introduction of Semantic Web, Semantic Web Architecture, The semantic web and the role of agents, Semantic Web Tools, Metadata: Syntax, Structure, Semantics, Social web and semantic web, Web 2.0/3.0, Ontology (OWL) and Reasoning on the web, Trust, Ontologies, Ontology languages, XML, RDF (Resource Description Framework), RDFS (RDF Schema), OWL (Web Ontology Language), Ontology Development using Protege editor, Ontology Querying, Ontology Reasoning and Description Logic (DL), Semantic Web Application Areas, Ontology programming with Jena API, Ontology Engineering, Latest trends and Research issues in Semantic Web.

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

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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-theloop integration, Parallel simulation, Architectures, Conservative time management, Optimistic time management

CS-5518 Rich Internet Applications (3)

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

CS-5519 Service Oriented Architectures (3)

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.

CS-5520 Real Time Operating Systems (3)

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.

CS-5521 Advanced Compiler Design (3)

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 instructionlevel parallelism, modulo scheduling, predicated and speculative execution. The class focus is processorspecific compilation techniques, thus familiarity with both computer architecture and compilers is recommended.

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.

National Institute of Urban Infrastructure Planning (NIUIP)

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 in Urban Infrastructure Planning and Engineering in Pakistan. NIUIP will play 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.

NIUIP aspires to play 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. Starting in Fall-2016, NIUIP is launching a full-time M.Sc program for both the Urban Infrastructure Engineering and Urban Infrastructure Planning & Management streams. The first of its kind in UET, this full-time program entails completion of a master's degree program within four years."



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DIRECTOR

Dr. Rashid Rehan	Ph.D. (Canada)
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ASSOCIATE PROFESSORS

Dr. Khan Shahzada	Ph.D. (Pak)

ASSISTANT PROFESSORS

Dr. Muhammad Adil	Ph.D. (UK)
Dr. Salman Saeed	Ph.D. (Canada
Dr. Sagheer Aslam	Ph.D. (Canada
Dr. Taimur Usman	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, and urban infrastructure engineering.
- 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 nongovernment organizations in urban infrastructure planning.

PROFESSIONAL AND ADVISORY SERVICES

NIUIP will play a vital role in providing advisory services on urban infrastructure project planning initiatives in Pakistan. NIUIP will be a think-tank for important policy making and regulatory issues, and will define standards for urban infrastructure planning and engineering projects. NIUIP is providing services in:

- Master planning of water supply systems.
- Master planning of sewerage systems.
- Transportation planning.
- Best management practice regarding Urban Hydrology and Hydraulics
- Low cost waste disposal systems.
- Environmental issues and regulatory compliance.
- Storm water system design.
- Asset management and condition assessment of water & sewer facilities.

AREAS OF RESEARCH AND STUDY

In addition to the core courses, students seeking post-graduate

degree at NIUIP (infrastructure engineering degree and/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 and Regional Planning
- Urban Hydrology and Hydraulics
- Land use Planning
- Urban Transportation Planning
- Urban Environment and Energy Planning
- Water Supply and Sanitation
- Solid Waste Management
- Spatial Modeling and GIS
- GIS Application to Infrastructure Projects
- Infrastructure Development and Finance
- Infrastructure Utilities Planning and Service Delivery

NIUIP OFFERS

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

ELIGIBILITY CRITERIA FOR 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

LIST OF APPROVED COURSES

CORE COURSES

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 guality 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

 Water Supply and Pollution Control by Warren Viessman Jr., Mark J. Hammer, Paul A. Chadik, Elizabeth M. Perez, 8th edition, Prentice Hall, June 2008, ISBN-13: 9780132337175 2. Water Distribution Modeling, Thomas M. Walski, Donald V. Chase, and Dragan A. Savic, Haestad Methods Inc. / Bentley Institute Press, 2001

UIE 5802 SEWERAGE SYSTEMS (3)

Urban Drainage and Sewerage: urban drainage types and characteristics, urban drainage systems, determination of inputs to urban drainage systems, hydraulics of sewer systems, modelling of urban drainage hydraulics and urban drainage design. Waste Water Treatment Process Design and Engineering: sewage characterisation, primary treatment, secondary treatment, state-of-the art technologies, sludge treatment and disposal, sludge characterisation, sewage and sludge treatment in practice. Modelling and Industrial Waste Water Treatment: modelling of activated sludge waste water treatment, and industrial effluent (characterisation, minimization and treatment options). Sustainable Waste Water Treatment and Re-use: anaerobic waste water treatment, natural systems for waste water treatment, and waste water re-use.

Recommended Books

- 1. Grigg, N.S "Water, Wastewater, and Storm-water Infrastructure Management" CRC Publishers
- Design and Construction of Urban Stormwater Management System, (Manual of Practice No.77), ASCE Press, Reston, VA, 1993.

 Wastewater Collection Systems Modeling and Design, by Thomas M. Walski, Thomas E. Barnard, LaVere B. Merritt, Eric Harold, Noah Walker, Brian E. Whitman, Haestad Methods Inc/ Bentley Institute Press.

UIE 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 2. Building Maintenance Management by Barrie Chanter and Peter Swallow, Wiley-Blackwell; 2 edition (September 4, 2007), ISBN-10: 1405135069

UIE 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 multicolor coding schemes, civil infrastructure inspections using 3d computer simulations.

Software Used: AutoCAD Civil 3D

UIE 5805 INTELLIGENT TRANSPORT SYSTEMS (3)

Basic Concepts, background, Application areas of Intelligent Transport Systems (ITS), ITS technologies; Information, communication and sensor technologies; Urban Traffic control, Discrete time optimization, Incident detection and congestion monitoring, dynamic driver information, Advanced Traffic Management Systems, Advanced Traveler Information Systems, Advanced Vehicle Control System, Commercial Vehicle Operations, Advanced Public Transport System, Electronic Payment System, Security and Emergency Response System. Working mechanism or ITS, Data acquisition. ITS architecture and standardization; ITS benefits and cost, myths and realities, implementation strategies, financing and contracts, Public-Private partnerships. Case study of ITS From Transitional economies to developing countries, India China, Brazil, Iran, South Korea, Chili etc.

Recommended Books

- Ian Catling (1993) Advanced Technology For Road Transport ;IVIHS and ATT, Boston London (ISBN 0-89006-613-2)
- 2. John C. Miles, Kan Chen (ed.) 2004 The Intelligent Transport Systems Handbook, Thomson Press India.
- 3. Evangelos Bekiaris (ed .et a1) (2004) Economic Impacts of intelligent Transportation system, Elsevier (ISBN 0-7623-0978-4)
- 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.; Traffic calming techniques applied both to through roads and to "sensitive" local networks; Reversible lanes solutions; Road pricing, Area Licensing etc.; "Incident" detection and management systems.

Recommended Books

- Randolph W. Hall (ed.) (2003) Hand book of Transportation Science. Kluwer Academic Publishers
- 2. Myer Kutz (ed.) 2004, Hand book of Transportation Engineering, McGraw-Hill.
- 3. Anthon Down (1992) Stuck in Traffic The Lincoln Institute of Land Policy (ISBN 0-8157-1923-X)
- 4. Georgina Santos (ed.) 2004 Road pricing. Theory And Evidence Elsevier Ltd, ISSBN(0-7623-0968-7)

UIE 5807 URBAN WATERSHED MANAGEMENT (3)

This course is concerned with a basic understanding of watershed management and the underlying
associated physical, chemical, and biological systems and processes associated with a watershed. The course will examine watershed management from a scientific/engineering perspective as well as from a policy perspective. The course will briefly touch the hydraulic, hydrologic, and water quality modeling performed in support of watershed management. Other contents include local and international policies and regulations in support of watershed management, watershed assessment, point and non-point sources of pollution, water quality based standards for water bodies, total maximum daily load (TMDL) for water bodies, and development of a watershed management framework for urban watershed.

Recommended Book

Watershed: Processes, Assessment, and Management by Paul A. DeBarry, published by Wiley (2004).

UIE 5808 INFRASTRUCTURE CONDITION ASSESSMENT (3)

Types of infrastructure considered will include road pavements, bridges, drainage and sewer systems, and water supply systems. Topics covered will include deterioration through material degradation and effects of the interaction between material properties, traffic loading and environment on pavement deterioration/performance, Pavement distress modes used in performance assessment maintenance and rehabilitation techniques, Technologies/equipment used in condition data collection, multi-laser profiler, non-destructive testing, accelerated load testing, etc; Condition monitoring technologies - indirect and direct, Rehabilitation methods - non-structural, semistructural and structural.

UIE 5809 INFRASTRUCTURE ASSET MANAGEMENT (3)

Review of the status of civil infrastructure, and analytical methods, tools, data, technologies, policies and economic/financial frameworks for managing infrastructure systems and facilities as assets. Condition Assessment: Data Needs for Infrastructure Management; Data Collection Technologies for Pavements, Bridges and Sewers. Deterioration Modeling: empirical, mechanistic, deterministic, stochastic, project and network level models. Engineering Economic Analysis: Present worth analysis, Effective interest rates, Perpetual life, Arithmetic and Geometric progressions, Inflation. Project Evaluation: Net Present Value, Benefit/Cost Analysis, Internal Rate of Return, Spreadsheet Financial Functions. Priority Assessment: Ranking Methods Priority Assessment: Mathematical Optimization. Infrastructure and Asset Management Systems/ Softwares. Best Practices in Asset Management.

Recommended Books

 Infrastructure Management by Hudson, Haas, and Waheed Uddin, McGraw Hill, ISBN 0-07-030895-0, 1997

- 2. International Infrastructure Management Manual, NAMS Group, New Zealand
- 3. Grigg, Neil, "Infrastructure engineering and management," Wiley, 1988.
- 4. Water, Wastewater, and Stormwater Infrastructure Management CRC Publishers; 1st edition 2002 Infrastructure Management by Hudson, Haas, and Uddin, McGraw-Hill Publication, N.Y.,

UIE 5144 SOLID WASTE MANAGEMENT (3)

Basic concepts in approaching and solving solid waste management problems. Health significance, collection, transport and various ways of disposal including incineration, sanitary landfill, composting, recovery and re-utilization.

Recommended Books

- 1. Hickman, Lanier H. Principles of Integrated Solid Waste Management, ISBN 1-883767-26-1, 1999.
- 2. Integrated Solid Waste Management: Engineering Principles and Management Issues by George Tchobanoglous, Hilary Theisen, Samuel Vigil.
- E.A. McBean, F.A. Rovers, G.J. Farquhar, Solid Waste Landfill Engineering and Design Prentice Hall PTR, 1995.

UIE 5890 SPECIAL TOPICS (3)

Any subject relevant to Urban Infrastructure Engineering.

UIE 5899 MASTER'S THESIS (6)

ELECTIVE COURSES

Apart from the following elective courses for the Engineering Degree Program, other courses for Infrastructure Planning and Management may be considered as Minor Course for the Engineering Degree Program with the approval of Director NIUIP.

UIE 5810 TRANSPORTATION PLANNING (3)

Technical and qualitative aspects of the urban transportation planning process, Urban travel characteristics and data collection methods: the urban transportation modeling system, including land use, trip generation, trip distribution, mode choice, and trip assignment models; site traffic impact studies; environmental impacts; project and plan evaluation; and technology options for urban transport. Transportation systems; technological characteristics of transport modes and systems. Land use-transportation inter-relationships. Travel demand forecasting. Planning of public transport systems; Intermediate public transport modes. Traffic flow characteristics; Traffic analyses and design considerations; design of intersections; traffic signals and street lighting; local area traffic management.

Recommended Books

- 1. Meyer, Michael D. and Eric J. Miller, Urban Transportation, Second Edition, McGraw Hill, New York, 2001.
- 2. C.S. Papcostas & P.D. Prevedouros, Transportation

Engineering and Planning, Prentice-Hall, 2nd Edition

 Roess, McShane & Prassas, Traffic Engineering, 3rd Edition, Pearson/Prentice-Hall Polytechnic Series, 2004. ISBN # 0-131-42471-8

UIE 5811 APPLICATION OF GIS/RS FOR URBAN INFRAST-RUCTURE 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

- Juliana Maantay, John Ziegler, and John Pickles (2006) "GIS for the Urban Environment" McGraw Hill
- 2. Ayse Pamuk (2006)"Mapping Global Cities: GIS Methods in Urban Analysis", ESRI Press

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

Introduction to International Disaster Management, by Damon P. Coppola, Butterworth -Heinemann; 1st edition (November 2, 2006) ISBN-10:0750679824.

UIE 5813 RENEWABLE ENERGY SYSTEMS (3)

This course aims to provide an introduction to key sustainable / renewable energy technologies. It is structured so as to familiarize students with the wide range of literature on sustainable energy technologies, and aims to develop further independent study, analysis, synthesis and presentation skills. The course will provide introduction to various technologies such as hydro, wind, wave, tidal, solar, biomass, geothermal, fuel cells, thermo-electric power, energy conversion, and combined heat and power systems. The course will briefly discuss the constraints on each technology both imposed by physical fundamentals, and by current levels of technology and market. The course will also consist of economic appraisal of renewable and conventional technologies to facilitate policy level decision making and long-term planning for energy needs.

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.

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

- 1. Levy, J.M. (2008) "Contemporary Urban Planning", Prentice Hall, ISBN-10: 0205701116
- 2. Marshall, T, and Glasson, J. 2007. Regional Planning. Abingdon, Oxfordshire, UK: Routledge.

UIP 5823 ENVIRONMENTAL LAWS & POLICY MAKING (3)

Introduction to Environmental Assessment, Definitions of Environmental Assessment, General Principles and Overview of Environmental Assessment. Introduction to Domestic Environmental Law, pertinent Guidelines of Pakistan Environmental Protection Agency regarding infrastructure projects and National Environmental Quality Standards. Examples of Domestic Environmental Law. Research into Domestic Environmental law. International Environmental Law – Foundations

of Environmental Law, Principles of International Environmental Law. Types of Environmental Assessments - Environmental Impact Assessment, Environmental Impact Statement, Risk Assessment/ Risk Analysis, Ecological Risk Assessment, Strategic Environment Assessment, Environmental Audit, Regional Risk Screening, Ecological Impact Assessment, Social Impact Assessments and Statements, Economic and Fiscal Impact Assessment, Health Impact Assessment. The Design and Process of Environmental Assessment – Steps in the Environmental Assessment Process (Scoping, Screening, Alternatives to the Proposal, Collection and Analysis of Information, Public Involvement, Reporting the Findings of the Study, Post Project Analysis) Study design (Baseline Studies, Predicting Impacts, Mitigation Measures), Data Collection and Analysis. Writing Environmental Reports, Examples of Suggested Lavouts for Environmental Assessments. Effective Report Writing. Mini Course Project entailing carrying out a small environmental assessment and writing it up as a professional report.

Recommended Books

1. Environmental Assessment in Practice by Owen Harrop and Ashley Nixon, Routledge Publishers, UK, ISBN: 978-0-415-15691-22. 2. Environmental Assessment by Ravi K. Jain, L. V. Urban, Gary S. Stacey, Harold E. Balbach, 2 edition (September 13, 2001), ISBN-10:0071370080

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.

UIP 5825 FINANCING OF INFRASTRUCTURE PROJECTS (3)

Fundamentals of Capital Project Financial Planning and Analysis. Concepts of economic and financial returns, cost of capital, discounting, risk and reward, Capital Budgeting in Government and Private Sector. Various Operating and Financing Structures: Government-owned, Privately-owned, and mixed Project Finance Structures. Transportation Finance: Highways and Toll Facilities, Airports, Ports and Terminals. Environmental and Energy Finance: Water supply and sewer, Power Electric/Gas. Recommended Books

- 1. Principles of Project Finance by E.R. Yescombe, Academic Press, ISBN-13: 978-0-12-770851-5, June 2002
- Principles of Project and Infrastructure Finance by Willie Tan ISBN: 978-0-415 41577-4 Published by: Taylor and Francis

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.

UIE 5150 ENVIRONMENTAL IMPACT ASSESSMENT (3)

Introduction to Environmental Impact Assessment (EIA) Definitions: Environmental Inventory; Environmental Assessment, Environmental Impact Statement. Methods and procedures for EIA. Format for organization of EIA Report. Design of an EIA. Legislative and Regulatory Considerations. Quality of Life Values components of EIA process. Assessment of impacts on water resources, modeling impacts of waste discharges on water quality in rivers. Estimating air quality Impact. Impact of Sanitary Landfills. Case studies of EIA: Thermal power plants, cement plants and industrialization in Pakistan.

Recommended Text:

Wood C (2003) Environmental Impact Assessment – A Comparative Review, 2nd edn, Prentice Hall, ISBN 0-582-36969-X

UIE 5181 PROJECT PLANNING AND ESTIMATING (3)

Pre-tender Planning, Pre-Contract Planning, Planning Techniques, Resource Analysis, Short Term Planning, Computer-Aided Planning, Infrastructure Project Monitoring and Control, Contract Documentation, Managing the Design Process, Pre-Contract Estimating, available planning techniques, resource scheduling techniques. Project Cycle, functioning of various federal and provincial project approval forums, such as, Executive Committee of National Economic Council (ECNEC), Central Development Working Party (CDWP) and Provincial Development Working Party (PDWP). Structure of a Project PC-1 Document and its various contents.

Recommended Books

- 1. Smith, N.J, Engineering Project Management, Blackwell Publishing, 2002
- Code of estimating practice. in RICS, M & E Procurement Guide., 6th Edition, CIOB / Longmans., 1997
- 3. Planning Commission of Pakistan Guidelines for preparation of PC-1 Documents for Projects.

UIE 5187 MANAGEMENT INFORMATION SYSTEMS FOR CONSTRUCTION PROJECT MANAGEMENT (3)

Information Management within the construction organization. The classification of Information Systems: Personal Information Systems. Managers' requirements: support for planning, control, and decision making at an operational and executive level. Modeling information flow. Information Technology: hardware, software, and communications equipment. The impact of Electronic Information Exchange, Multi-Media, Knowledge Management, Intelligent Systems and e-Business. The development of a Management Information Systems [MIS] strategy for an organization. Systems development. Systems selection and acquisition and implementing new systems within construction organizations.

Recommended Books

- 1. Laudon, K. C. & Laudon, P. L., Management information systems, organization and technology., 6th End, Prentice-Hall, New Jersey, USA, 2000
- Paulson, Boyd, C. Jnr., Computer applications in construction., McGraw-Hill International editions, McGraw-Hill Inc., New York. USA., 1995

Urban Infrastructure Planning & Management (Degree Programme)

NIUIP also offers masters degree programme in Urban Infrastructure Planning and Management in addition to the M.Sc degree programme 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 programme in Urban Infrastructure Planning & Management will train 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

In addition to the above major areas, students will have the option to choose from a wide range of elective courses related to urban infrastructure planning and management as described in the course details given in the following sections.

Urban Infrastructure Planning & Management

ELIGIBILITY CRITERIA FOR URBAN INFRASTRUCTURE PLANNING & MANAGEMENT DEGREE PROGRAMME:

Undergraduate degrees (04 or 05 years Bachelors i.e. total of minimum16 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 Programme:

- Civil Engineering
- Transportation Engineering
- Water Resource Engineering
- Sanitary Engineering
- Environmental Engineering
- Geoinformatics Engineering
- Agriculture Engineering
- Industrial Engineering
- Engineering Management

LIST OF APPROVED COURSES

CORE COURSES

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 incomegenerating 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 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

- 1. Urban Design: A Topology of Procedures and Products by Jon Lang (2005)
- The Urban Design Handbook: Techniques and Working Methods by Urban Design Associates (UDA) (2003)

UIP 5890 SPECIAL TOPICS (3)

Any subject relevant to Urban Infrastructure Planning & Management.

UIP 5899 MASTER'S THESIS (6)

ELECTIVE COURSES

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

 Levy, J.M. (2008) "Contemporary Urban Planning", Prentice Hall, ISBN-10: 0205701116 2. Marshall, T, and Glasson, J. 2007. Regional Planning. Abingdon, Oxfordshire, UK: Routledge.

UIP 5823 ENVIRONMENTAL LAWS & POLICY MAKING (3)

Introduction to Environmental Assessment, Definitions of Environmental Assessment, General Principles and Overview of Environmental Assessment. Introduction to Domestic Environmental Law, pertinent Guidelines of Pakistan Environmental Protection Agency regarding infrastructure projects and National Environmental Quality Standards. Examples of Domestic Environmental Law. Research into Domestic Environmental law. International Environmental Law – Foundations of Environmental Law, Principles of International Environmental Law. Types of Environmental Assessments - Environmental Impact Assessment, Environmental Impact Statement, Risk Assessment/ Risk Analysis, Ecological Risk Assessment, Strategic Environment Assessment, Environmental Audit, Regional Risk Screening, Ecological Impact Assessment, Social Impact Assessments and Statements, Economic and Fiscal Impact Assessment, Health Impact Assessment. The Design and Process of Environmental Assessment - Steps in the Environmental Assessment Process (Scoping, Screening, Alternatives to the Proposal, Collection and Analysis of Information, Public

Involvement, Reporting the Findings of the Study, Post Project Analysis) Study design (Baseline Studies, Predicting Impacts, Mitigation Measures), Data Collection and Analysis. Writing Environmental Reports, Examples of Suggested Layouts for Environmental Assessments, Effective Report Writing. Mini Course Project entailing carrying out a small environmental assessment and writing it up as a professional report.

Recommended Books

- 1. Environmental Assessment in Practice by Owen Harrop and Ashley Nixon, Routledge Publishers, UK, ISBN: 978-0-415-15691-2
- 2. Environmental Assessment by Ravi K. Jain, L. V. Urban, Gary S. Stacey, Harold E. Balbach, 2 edition (September 13, 2001), ISBN-10:0071370080

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.

UIP 5825 FINANCING OF INFRASTRUCTURE PROJECTS (3)

Fundamentals of Capital Project Financial Planning and Analysis. Concepts of economic and financial returns, cost of capital, discounting, risk and reward, Capital Budgeting in Government and Private Sector. Various Operating and Financing Structures: Government-owned, Privatelyowned, and mixed Project Finance Structures. Transportation Finance: Highways and Toll Facilities, Airports, Ports and Terminals. Environmental and Energy Finance: Water supply and sewer, Power Electric/Gas.

Recommended Books

- 1. Principles of Project Finance by E.R. Yescombe, Academic Press, ISBN-13: 978-0-12-770851-5, June 2002
- Principles of Project and Infrastructure Finance by Willie Tan ISBN: 978-0-415 41577-4 Published by: Taylor and Francis

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.

UIE 5150 ENVIRONMENTAL IMPACT ASSESSMENT (3)

Introduction to Environmental Impact Assessment (EIA) Definitions: Environmental Inventory; Environmental Assessment, Environmental Impact Statement. Methods and procedures for EIA. Format for organization of EIA Report. Design of an EIA. Legislative and Regulatory Considerations. Quality of Life Values components of EIA process. Assessment of impacts on water resources, modeling impacts of waste discharges on water quality in rivers. Estimating air quality Impact. Impact of Sanitary Landfills. Case studies of EIA: Thermal power plants, cement plants and industrialization in Pakistan.

Recommended Books

Wood C (2003) Environmental Impact Assessment – A Comparative Review, 2nd edn, Prentice Hall, ISBN 0-582-36969-X

UIE 5181 PROJECT PLANNING AND ESTIMATING (3)

Pre-tender Planning, Pre-Contract Planning, Planning Techniques, Resource Analysis, Short Term Planning, Computer-Aided Planning, Infrastructure Project Monitoring and Control, Contract Documentation, Managing the Design Process, Pre-Contract Estimating, available planning techniques, resource scheduling techniques. Project Cycle, functioning of various federal and provincial project approval forums, such as, Executive Committee of National Economic Council (ECNEC), Central Development Working Party (CDWP) and Provincial Development Working Party (PDWP). Structure of a Project PC-1 Document and its various contents.

Recommended Books

- 1. Smith, N.J, Engineering Project Management, Blackwell Publishing, 2002.
- Code of estimating practice. in RICS, M & E Procurement Guide., 6th Edition, CIOB / Longmans., 1997

3. Planning Commission of Pakistan Guidelines for preparation of PC-1 Documents for Projects.

UIE 5187 MANAGEMENT INFORMATION SYSTEMS FOR CONSTRUCTION PROJECT MANAGEMENT (3)

Information Management within the construction organization. The classification of Information Systems: Personal Information Systems. Managers' requirements: support for planning, control, and decision making at an operational and executive level. Modeling information flow. Information Technology: hardware, software, and communications equipment. The impact of Electronic Information Exchange, Multi-Media, Knowledge Manag-ement, Intelligent Systems and e-Business. The development of a Management Information. Systems [MIS] strategy for an organization. Systems development. Systems selection and acquisition and implementing new systems within construction organizations.

Recommended Books

- 1. Laudon, K. C. & Laudon, P. L., Management information systems, organization and technology., 6th End, Prentice-Hall, New Jersey, USA, 2000
- Paulson, Boyd, C. Jnr., Computer applications in construction., McGraw-Hill International editions, McGraw-Hill Inc., New York. USA., 1995

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 alongwith 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. Amjad Ali	Ph.D. (Pak)
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Prof. Dr. Ali Muhammad	Ph.D. (Pak)
ASSOCIATE PROFESSOR	
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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. Rehan Ali Shah	Ph.D (Pak)
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Mr. Qayyum Shah	M.Sc (Pak)
Dr. Najeeb Ullah	Ph.D (UK)
Mr. Iqbal-ud-Din Arif Utman	M.A (Pak)
Mr. Jamal Nasir	M.Phil (Pak)
Miss. Gulandam Farhat	M.A (Pak)
Mr. Haseen Ullah Jan	M.Phil (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 atleast 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 e registered as credit course.

ELIGIBILITY

- Candidates seeking admission must have M.Sc in Mathematics (16 years) or BS four years degree from accredited Institutions, securing atleast 60% marks in annual system or atleast CGPA 3 in the semester system.
- 2. Candidates seeking admission must score atleast 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.

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.

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)

Cauchy's Problems for Linear Second Order P.D Equations in n-Independent Variables. Cauchy Kowalewski Theorem. Characteristic surfaces. Adjoint operations, Bicharacteristics. Spherical and Cylindrical Waves. Heat equation, Wave equation, Laplace equation, Maximum-Minimum Principle, Integral Transforms. Recommended Books:

- Dennemyer, R., Introduction to Partial Differential Equations and Boundary Value Problems, McGraw-Hill Book Company, 1968.
- 2. Chester, C.R., Techniques in Partial Differential Equations, McGraw-Hill Book Company, 1971.

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:

- 1. R. Aris, Mathematical Modeling Techniques, Dover, 1994.
- C. L. Dym and E.S, Ivey, Principles of Mathematical Modeling, Academic Press, 1980.
- 3. M.S Klamkin, Mathematical Modeling: Classroom Notes in Applied Mathematics, SIAm, 1986.
- 4. A. Friedman and W.Littman, Industrial Mathematics for Undergraduate, SIAM, 1994.
- 5. Y. C. Fung, A First Course in Continuum Mechanics,

Prentice Hall, 1969.

- E. N. Lightofoot, Transport Phenomenon and Living Systems, Wiley, 1974.
- M. Braun, C.S. Coleman and D.A. Drew, Differential Equation Models, Modules in Applied Mathematics, Volume1, Springer Verlag, 1978.

BSI 5018 MATHEMATICAL METHODS (Core: 3)

General solution of Bessel equation, Recurrence relations, Orthogonality of Bessel functions, Modified Bessel functions, Applications. General solution of Legendre equation, Legendre polynomials, Associated Legendre polynomials, Rodrigues formula, Orthogonality of Legendre polynomials, Application. Concept and calculation of Green's function, Approximate Green's function, Green's function method for differential equations, Fourier Series, Generalized Fourier series, Fourier Cosine series, Fourier Sine series, Fourier integrals. Fourier transform, Laplace transform, Z-transform, Hankel transform, Mellin transform. Solution of differential equation by Laplace and Fourier transform methods.

Recommended Books:

- 1. G.N. Watson, A Treatise on the Theory of Bessel Function, Cambridge University Press, 1944.
- G.F Roach, Green's Functions, Cambridge University Press, 1995.
- A. D, Poularikas, The Transforms and Applications Handbook, CRC Press, 1996.
- 4. J.W Brown and R. Churchill, Fourier Series and Boundary value problems, McGraw Hill, 1993.

BSI 5020 STATISTICAL DECISION THEORY (3)

Decision functions, Risk functions, Utility and subjective probability, Randomization, Optimal decision rules, Admissibility and completeness, Existence of Bayes decision rules, Existence of minimal complete class, Essential completeness of the class of nonrandomized rules. The minimax theorem. Invariant statistical decision of problem. Multiple decision problems. Sequential Decision problems.

Recommended Books:

- 1. J.O. Berger, Statistical Decision Theory: Foundations, Concepts and Methods, Springer Verlag, 1980.
- 2. T.S Fegguson, Mathematical Statistics, Academic Press, 1967.

BSI 5021 PARALLEL ALGORITHMS (3)

Theoretical models of parallel computation: Variants of the PRAM model. Performance of parallel algorithms.

Basic Techniques: Balanced trees, recursive doubling, divide and conquer, partitioning. Pipe lining, Accelerated cascading, symmetry breaking. List ranking, the euler tour techniques, tree contraction. Algorithms for searching, merging and sorting. Graph algorithms: Connected components, coloring. Parallel algorithms on interconnection networks and other architectures. Limits to parallelizability. P-completeness.

Recommended Books:

1. J. O. Berger, Statistical Decision Theory: Foundations, Concepts and Methods, Springer Verlga, 1980.

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2. T.S Ferguson, Mathematical Statistics, Academic year Press, 1967.

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:

- 1. Weatherburn, C.E., "A first Course in Mathematical Statistics" Cambridge University Press. 1968.
- Freund, J.E. "Mathematical Statistics" Prentice Hall, 1962.
- Hogg, R.V. and Criag, A.T. "Introduction of Mathematical Statistics," (Fifth edition) Prentice Hall, 1995.
- 4. Hoel, P.G. "Introduction to Mathematical Statistics," John Wiley and sons. 1984.
- 5. A. Papoulis, Probability, Random Variables and Stochastic Processes, McGraw Hill, 1985.
- 6. H.J. Larson, Introduction to Probability Theory and Statistical Inference, 3rd edition, Wiley, 1969.
- H. Stark and J.W Woods, Probability, Random Processes and Estimation Theory for Engineers, prentice Hall, 1986.
- 8. Spiegel, M.R. "Probability and Statistics" Schaum's Outline Series, McGraw-Hill. 1982.

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:

- 1. F. Riesz and Nagy "Functional Analysis", Frederick Ungar Publishing Co.1995.
- 2. E. Kreyszing "Introductory Functional Analysis With Applications", John, Wiley and Sons, New York. 1989.
- 3. A.E. Taylor "Introduction to Functional Analysis", Wiley International Edition, New York. 1957.
- 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:

- 1. Ulrich Trottenberg and Anton Schuller, Multigrid. Academic Press, Inc., Orlando, FL, USA, 2001.
- 2. P. Wesseling. An Introduction to Multigrid Methods. John Wiley and Sons, 1992.
- 3. Ke Chen. Matrix Preconditioning Techniques and Applications. Cambridge University Press, 2005.

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 guadrature. Conjugate gradient (CG) method, Bi-Orthogonalization method.

Recommended Books:

1. Lloyd Trefethen and David Bau, Numerical Linear Algebra, SIAM 1997.

BSI 5058 ADVANCED COMPLEX ANALYSIS (Core: 3)

Contour Integration:

Review of Laurent's Series, Zeros of Analytic Functions, Singularities, Poles, Residues at Poles, Cauchy's Residues Theorem with applications. Expansion of Functions and Analytic Continuation" Mittage Leffler's Theorem with applications, The Weierstrasses' Theorem with applications, The Principle of analytic continuation, Reflection Principle. Elliptic function, Doubly periodic functions, Relation between the zeros and poles of an elliptic function, The Weirestrasse's function P(z), Addition theorem, A differential equation for P(z). The Zeta function, Sigma function and their applications.

Recommended Books:

- 1. L.L. Pennissi, Introduction to Complex Variables, 1976.
- 2. J.W. Brown and R.V Churcill, Complex Variables and Application, 7th Edition, 2003.
- 3. D.G. Zil and M.R Cullen, Differential Equations with Boundary Value Problems, 2000.
- 4. E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, 2006.
- 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:

 Handbook of Splines (Mathematics and Its Applications), Gheorghe Micula, Sanda Micula, 1st edition (1998)

BSI 5040 INTEGRAL TRANSFORM AND ITS APPLICATION (Core:3)

Fourier Transform, Applications to ODEs, Applications to PDEs, Fourier Cosine and Sine Transforms, Applications to PDEs, Multiple Fourier Transforms and Applications, Laplace Transform- Definition and Properties, Convolution, Differentiation and Integration, Inverse Laplace Transform, Watson's 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:

- 1. Integral Transforms for Engineers, by Larry C., Andrews, Bhimsen K. Shivamoggi, (2004)
- 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 tensorproduct splines, Topics in multi-variate splines, box splines, Other topics depending on topics and interests.

Recommended Books:

 The Theory of Splines and Their Applications Ahlberg, E.N. Nilson, J.L. Walsh, Academic Presss, 28-Jun-1967-Mathematics.

BSI 5030 MATHEMATICAL BIOLOGY (Core:3)

Population dynamics. Growth and spatial spread of organisms. Fisher's equation. Epidemiology - the spread of plagues. Reaction-Diffusion models: Turing mechanism for pattern formation. How the leopard got

his spots (and sometimes stripes). Enzyme Kinetics and chemical reactions: Michaelis-Menten theory. Hormone cycles, neuron-firing. Mass transport; Taylor dispersion.

Recommended Books:

- 1. James D. Murray, Mathematical Biology: I. An Introduction SIAM (2004).
- 2. Elizabeth S. Allamn, Mathematical models in Biology: An Introduction.

BSI 5558 DIFFERENTIAL GEOMETRY–I (Core:3)

Manifolds: Definition, examples, importance and applications, Tensor and its basic algebra, Dimension of manifold, Tangent and cotangent vectors, Sub manifolds, Topology of manifolds. Tensors: Definition, examples, importance and applications, Tensor and its basic algebra, Differential forms, Tensors and a point. Tensor components, Order and rank of tensors, Tensor filed. Some fundamental operations with tensors, Cotravariant and covariant tensors. Lie Groups, Geodesics, Curvature, Integration on Manifolds: Orientation of Manifolds, Integrals of forms.

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.
- 3. Differential Geometry by Erwin Kreyszig.

BSI 5559 GENERAL RELATIVITY (3)

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

(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 2dimensional 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:

- 1. General Relativity by Robert M. Wald.
- 2. The Large Scale Structure of Space-time by S.W. Hawking and G.F.R. Ellis.
- 3. Symmetries and Curvature Structure in General Relatively by G.S. Hall.

BSI 5560 MESHLESS AND OTHER ADVANCED NUMERICAL METHOD (Core:3)

Introduction, Meshless methods in science and engineering, Principle of weak and strong formulations, Local and global meshless methods in strong form, Meshless Galerkin methods, Local collocation and Petrov-Galerkin methods, Point interpolation methods, Meshless methods in fluid dynamics problems, Meshless methods for re-constructions of a function. Meshless methods for shells. Combinations of meshless and other numerical methods as well as numerical implementation.

Recommended Books:

- 1. G.R. Liu, Mesh free methods, CRC Press, Boca raton, 2003.
- 2. S.N Atluri, S.Shen, The meshless local Petrov-Galerkin method, Tech. Science Press, 2002.
- M.A Golberg and C.S Chen, Discrete Projection Methods for Integral Equations, Computational Mechanics Publications, Southampton, Boston, 1997.

LIST OF APPROVED Ph.D COURSES

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

Numerical methods for Parabolic PDEs; review of finite difference methods, explicit methods, Crank-Nicolson implicit method, Fourier stability methods, alternating directions implicit method, higher level schemes, nonlinear equations, predictor corrector methods, computer problems. Numerical methods for elliptic PDEs; Guass-Seidel method, successive over-relaxation method, rates of convergence, alternating directions implicit method, conjugate gradient method, Galerkin method, irregular regions, artificial boundaries, computer problems. Numerical methods for hyperbolic PDEs; explicit methods, D'Alembert's exact solution, method of characteristics, Lax-Wondroff method, method of artificial viscosity, higher dimensions, Courant-Friedrichs-Lewy condition, computer implementations.

Recommended Books:

- K.W. Morton and D.F. Mayers, Numerical Solution of Partial Differential Equations, Cambridge University Press, New York, 1994.
- A.R. Mitchell and D.F Griffiths, The Finite Difference Methods in Partial Differential Equations, Wiley, 1980.

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, Bifuercations, 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:

1. Nonlinear Dynamics And Chaos: With Applications to

Physics, Biology, Chemistry, and Engineering, by Steven H. Strogatz, Westview Press; 1st edition (2001)

BSI 5674 ADVANCE FLUID DYNAMICS (Core:3)

Review of gradient divergence and curl. Elementary ideas of tensors. Vorticity of fluid, Streamlines and path lines, Steady and unsteady flows, Velocity potential, Vorticity vector, Conservation of mass, Equation of continuity. Equations of motion, Bernoulli's equation. Singularities of flow, Source, Sink, Doublets, Rectilinear vortices. Complex variable method for twodimensional problems, Complex potentials for various singularities, Circle theorem, Blasuis theorem, Theory of images and its applications to various singularities. Three dimensional flow, Irrotational motion, Weiss's theorem and its applications. Viscous flow, Vorticity dynamics, Vorticity equation, Reynolds number, Stress and strain analysis, Navier-Stokes equation, Boundary layer Equations.

Recommended Books:

- 1. N. Curle and H. Davies, Modern Fluid Dynanics, Van Nostrand Reinhold, 1966.
- 2. L. M. Milne Thomson, Theoretical Hydrodynamics, Macmillan and Co., 1960.
- G.K. Batchelor, An Introduction to Fluid Dynamics, Cambridge University Press, 1993.
- 4. F. Chorlton, A Text Book of Fluid Dynamics, Von Nostrand Reinhold/CBS, 1985.
- 5. A.R Patterson, A First Course in Fluid Dynamics, Cambridge University Press, 1992.

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 Mmatrices, 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:

- 1. Michael T. Heath: Scientific Computing. An Introductory Survey, 2nd Ed McGraw Hill 2002
- 2. (Optional) Cleve Moler Numerical Computing with MATLAB SIAM books 2004.
- (Optional) W. Press, S. Teukolsky, W. Vetterling and B. Flannery. Numerical Recipes in C Cambridge University Press, 1966.
- 4. Schilling, R. and Harris, S. (2000) Applied Numerical Methods for Engineers.
- 5. Borse, G. (1997) Numerical Methods with MATLAB, ITP Books.
- 6. Cheney, W. and Kincaid, D. (1999) Numerical Mathematics and Computing (4th Ed.) ITP Books.

7. Alfio Quarteroni, Ricardo Sacco and Fausto Saleri: Numerical Mathematics Springer Verlag, 2000.

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:

- 1. Variational Methods in Imaging, by Otmar Scherzer, Harald Grossauer.
- 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.

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3. Handbook of Mathematical Models in Computer Vision.

BSI 5678 ADVANCED GENERAL RELATIVITY

Einstein's Field Equations and General Relativity, Einstein's Field Equation, The geometry and physics of universe and their relation, Space-time and 4dimentional manifold, Space-time and Tetrad. Homogenous and Isotropic Cosmology, Some Special solutions of EFE. The Schwarzschild solution, Schwarzschild Vacuum static space time, Derivation of the Schwarzschild solution, Interior solutions, Birkhoffs theorem, Stationary, Axisymmetric Solutions, Spatially homogeneous Cosmologies, Algebraically Special Solutions Perturbations, Singularity, Singularity theorems. Time like and null geodesics, Congruences, Conjugate points, Existence of Maximum Length Curves, Black holes and the cosmic sensor conjecture, General properties of Black Holes, the Charged Kerr Black Hole.

Recommended Books:

- 1. General Relativity by Robert M. Wald, University of Chicago Press, 1984.
- The Large Scale Structure of Space-time by S.W. Hawking and G.F.R. Ellis, Cambridge University Press, 2003.
- 3. Exploring Black Holes: Introduction to General Relativity by John Archibald wheeler.

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:

- 1. S. Gallot et al, Riemannian Geometry, Springer Verlag 1990.
- 2. T.J. Willmore, Riemannian Geometry, OUP 1993.
- 3. Y. Choquet-Bruhat et al, Analysis, Manifolds and Physics Part I, North-Holland 1991
- 4. V. Guillemin et al, Differential Topology, Prentice-Hall 1974

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, semiperametric, baysien parametric) non-parametric

model, smoothing spline, kernel regression, estimation (Model based) kernel and smoothing methods.

Recommended Books

- 1. Basic Econometric, Gujarati, 5th Edition.
- 2. Econometric Analysis, 5th Edition by Greene
- 3. Applied Multivariate Statistical Analysis, 2nd Edition, W. Hardle.
- 4. Regression method in biostatistics, Linear, Logistic, Survival model by Eric Vittinghoff, 3rd Edition.
- BSI 5090 SPECIAL STUDIES (3)
- BSI 5091 RESEARCH METHODOLOGY (2)
- BSI 5099 MASTER'S THESIS (6)
- BSI 6099 Ph.D. THESIS (1-9)

U.S.-Pakistan Center for Advanced Studies in Energy

Introduction

The U.S.-Pakistan Center for Advanced Studies in Energy (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. 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.

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

U.S.-Pakistan Center for Advanced Studies in Energy, 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.

Dr. Najeebullah

Director

Ph.D. (UK)

ELECTRICAL ENERGY SYSTEM ENGINEERING

Assistant Professor Dr. Abdul Basit

Ph.D. (Denmark)

MATERIALS FOR ENERGY STORAGE & CONVERSION

Assistant Professors

Dr. Saim Saher	Ph.D. (Netherlands)
Dr. Muhammad Noman	Ph.D (Italy)

USPCAS-E UET Peshawar

M.Sc. PROGRAMS AT USPCAS-E UET PESHAWAR

- Electrical Energy System Engineering
- Materials for Energy Storage and Conversion

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

System Design and Regulation, Distributed Generation, Power Systems and High Voltage Plant Technology, Alternative Energy Systems, Power System Control and Protection, Smart Metering, Smart Grids and Active Network Devices.

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 32 Credit Hours including 2 CH course of Research Methodology:

List of Core Courses in M.Sc. in Electrical Energy System 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)
- 6. CAS-EESE 506 Renewable Electrical Energy Systems (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)

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 and Holbert; John Wiley.

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 states-pace 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, buckboost, 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:

1. Power Electronics: Converters, Applications and Design, by N. Mohan, T.M. Undeland, W.P. Robbins, Wiley, 3rd ed.

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,

CAS-EESE 506 Renewable Electrical Energy Systems [3CH]

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

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Recommended Book:

1. Grid integration and dynamic impact of wind energy by V. Vittal, R. Ayyanar, Springer

CAS-EESE 507 Distributed Generation [3CH]

Introduction to Distributed Generation, Definition and types of Distributed Generation technologies with DG capacities, Applications of Distributed Generation (DG), Impact of Distributed Generation on Power System Grids, Voltage Regulation, Losses, Harmonics, and Short Circuit Levels of the Network; Influence of DG, Influence of DG in service and product quality; Location of DG in the Distribution Networks and its Topology, Distributed Power System Reliability, Islanding of a Power Networks, Microgrids.

Recommended Books:

- 1. Electric Power Distribution Reliability, Second Edition by Richard E. Brown
- 2. Integration of Distributed Generation in the Power System by Math H. Bollen, Fainan Hassan
- 3. Electric Power Distribution Handbook, Second Edition by Thomas Allen Short

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

Impact of fossil and nuclear Fuel Based Electrical energy System, Role of Renewable Energy based Electrical System, Impact of high voltage transmission lines. Health effects of electricity generation, Energy Conservation, Assessment of cogeneration cycles and demand side management. Emission Impacts and its control in electric utilities.

Recommended Books:

- Electric Energy: An Introduction, Third Edition (Power Electronics and Applications Series) by Mohamed A. El-Sharkawi
- 2. Energy and the Environment by Robert A. Ristinen , Jack P. Kraushaar

CAS-EP 520 Research Methodology [2CH]

Define research; research terms; researchprocess and the principle activities, skills and ethics associated with theresearch 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:

 Investigating the Social World: The Process and Practice of Research, by Schutt, R. K. (7th edition). Los Angeles: Sage.

CAS-EP 521 Management of Technology& Innovation (MOTI) [3CH]

Technology and Competitiveness, Business Strategy and Technology Strategy, The Role of Technology in Creation of Wealth, Critical Factors in Managing Technology, Management of Technology: The New Paradigms, Technology Life Cycle, The process of Technology Innovation, Technology Planning, The Acquisition and Exploitation of Technology, Technology Transfer.

Recommended Books:

- 1. Management of Technology (The Key to Competitiveness and Wealth Creation), by Tarek M. Khalil.
- 2. The Management of Technological Innovation Strategy and Practice, Revised Edition by Mark Dodgson, David M. Gann, and Ammon Salter,Oxford University Press.

CAS-EP 522 Technology Entrepreneurship [3CH]

Entrepreneurship and Entrepreneurial mind-set, Entrepreneurial Intentions and Corporate Entrepreneurship, Entrepreneurial Strategy: (Generating and exploiting new entries), Creativity and the business plan, Identifying and analyzing domestic and International Opportunities, Protecting the Idea and other Legal Issues for the Entrepreneur, The Business Plan, The Marketing Plan, The Organizational Plan, The Financial Plan, Strategies for Growth and Managing the Implication of Growth.

Recommended Book:

1. Entrepreneurship by Robert D-Histrich / Micheal P. Peters / Dean A.Shepherd.

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]

USPCAS-E UET Peshawar

M.Sc. in Materials for Energy Storage and Conversion

Introduction

The world is exploring various sources of energy and has successfully identified and exploited novel materials for energy creation and application. There is a big demand throughout the world for making novel materials for energy creation. The fast transformation in the world of materials for fuel cells, solar cells, wind turbines, batteries and photocatalysis compel us for finding and exploiting opportunities of local manufacturing and training facilities. This interdisciplinary M.Sc. program will bring chemists, physicists, and engineers under one roof to work together as teams and thus bring technical revolution to meet local energy demands.

Focus Areas

Fuel Cells, Solar cells, Batteries, Photocatalysts, Wind Energy Materials.

Eligibility Criteria

- B.Sc. in Mechanical Engineering
- B.Sc. in Chemical Engineering
- B.Sc. in Electrical Engineering
- B.Sc. in Material Engineering
- B.Sc. Industrial Engineering
- B.Sc. in Mechatronics Engineering
- *M.Sc./BS in Physics
- *M.Sc./BS in Chemistry
- *M.Sc./BS in Electronics

- *M.Sc./BS in Nanotechnology
- *M.Sc./BS in Material Science
- Other related Engineering disciplines
- * Minimum 16 years of education

Seat Allocation

Seat allocation (per semester) for M.Sc. in Materials for Energy Storage and Conversion: 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 32 Credit Hours including 2 CH course of Research Methodology:

List of Core Courses in M.Sc. in Materials for Energy Storage and Conversion

- 1. CAS-ME 501 Materials Science and Properties of Materials (3)
- 2. CAS-ME 502 Electrochemistry (3)
- 3. CAS-ME 503 Electrical and Optical Properties of Materials (3)
- 4. CAS-ME 504 Materials Characterization Techniques (3)
- 5. CAS-ME 505 Nanofabrication Techniques (3)
- 6. CAS-ME 506 Advanced Materials for Energy Application (3)
- 7. CAS-ME 507 Survey for Energy Technologies (3)

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- 8. CAS-ME 508 Thin Films Technology (3)
- 9. CAS-ME 511 Materials Thermodynamics (3)
- 10. CAS-EP 521 Management of Technology and Innovation (3)

Note: 6 core courses must be taken from the above list while the following four are compulsory.

- i. CAS-ME 501 Materials Science and Properties of Materials
- ii. CAS-ME 502 Electrochemistry
- iii. CAS-ME 503 Electrical and Optical Properties of Materials
- iv. CAS-EP 521 Management of Technology and Innovation
- CAS-ME501 Materials Science and Properties of Materials [3CH]

Review of materials science and engineering concepts. Basic material properties and materials selection charts. Case studies in materials selection (focus on modulus, strength and toughness of metals, ceramics and polymers. Examples from solar module materials (which must have a 25-year lifetime) and batteries (where weight is an issue). Multiple constraints and compound objectives. Mechanical properties of Nano composites, CNTs and graphene. Interaction of materials, processing and design. Design process and materials selection methodology. Economics of materials and manufacturing processes. Recommended Books:

- 1. Materials Selection in Mechanical Design, 3rd Edition, by Michael F. Ashby, Butterworth and Heinemann,
- 2. Selection and Use of Engineering Materials, 3rd Edition, by J A Charles, F A A Crane and J A G Furness, Butterworth and Heinemann,

CAS-ME 502 Electrochemistry [3CH]

Thermodynamic fundamentals – Enthalpy, entropy, free energy, chemical equilibrium

Electrolytes – conduction in different medium i.e Aqueous, molten, ionic liquids and solid ionic conductors.

Electrodes – EO and Ecell, Effect of Concentration, Nernst equation

Electrical double layer – surface potential, stability of micro- and nano-particles

Electrode kinetics – the rate of electron transfer between the metal and species in solution, The transport of material to and from the electrode interface.

Technology – Electrochemistry in Fuel cells, primary and secondary batteries, flow batteries, supercapacitors, third generation solar cell, electrolysis.

Photo-electrochemistry $-H_2$ production from water, reduction of carbon dioxide to useful chemicals, photodegradation of hazardous chemicals.

Recommended Books:

- 1. Electrochemistry, 2nd Edition by Carl H Hamann, Andrew Hamnett and WolfVielstich.
- 2. Physical Electrochemistry, Fundamentals, Techniques and Applications by Eliezer Gileadi,
- 3. Electrochemical Methods, Fundamentals and Applications by Allen J Bard and Larry R Faulkener
- 4. Electroanalytical Methods: Guide to Experiments and Applications by Scholz, Fritz

CAS-ME 503 Electrical and Optical Properties of Materials [3CH]

Electrical properties of metals, semiconductors and dielectrics. Band structure of electron states, bandstructure calculation and transport properties of selected semiconductors. Band tuning, quantum dots and quantum well. LEDS and Conducting polymers. Electrons in strong magnetic fields, ohmic contacts and Fermi surface determination. Semiconductors (Intrinsic, Extrinsic), the physics of semiconductor devices and superconductors.

Recommended Books:

- 1. Physics of Semiconductor Devices by Colinge, J. P and Colinge, C.A.
- Electrical Properties of materials, 9th Edition by Laszlo Solymar, Donald Walsh, and Richard R. A. Syms
- 3. Optical Materials by Simmons and Potter.

CAS-ME 504 Materials Characterization Techniques [3CH]

Basic principles and applications of the following techniques: Scanning electron microscopy and transmission electron microscopy. Atomic force microscopy (AFM) and x-ray diffraction (XRD). Ultimate Testing Machine (UTM) and Nondestructive Testing (NDT). Inductive couple plasma. Thermal gravimetric analysis and differential thermal analysis. XRays photoelectron spectroscopy (XPS) and Electron energy Loss spectroscopy (EELS). Raman and FTIR spectro-photometry.

Recommended Books:

- Advanced Techniques for Materials Characterization by A. K. Tyagi, Mainak Roy, S. K. Kulshreshtha and S. Banerjee
- Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, 2nd Edition by Yang Leng

CAS-ME 505 Nanofabrication Techniques [3CH]

Introduction to device application. Shift in Device application from macro-scale to nano-scales. Basic patterning techniques (lithography, and etching). Thin film deposition processes, growth and microstructure. Comparison of classical methods vs emerging technologies. Classic methods: Photolithography, electron beam lithography and their limitations. Emerging technologies: focused
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ion beam lithography, scanning probe lithography, soft lithography and bio-molecular patterning.

Recommended Book:

- 1. The Science and Engineering of Microelectronic Fabrication by Campbell.
- CAS-ME 506 Advanced Materials for Energy Applications [3CH]

Advance materials for fuel cells, solar cells, wind energy and batteries. Advanced materials for cathodes, anodes and electrolyte for fuel cells and batteries. Materials for solar cells (first to third generation).

Recommended Books:

- 1. Energy Production and Storage: Inorganic Chemical Strategies for a Warming World by Robret H Crabtree
- 2. Rechargeable Batteries by Zhang, Zhengcheng, Zhang, Shengshui
- 3. Solar Cell Materials: Developing Technologies by Gavin Conibeer and Arthur Willoughby
- 4. Fuel Cell Fundamentals by Ryan O' Hayre, Suk Won Materials for Fuel Cells by M Gasik

CAS-ME 507 Survey of Energy Technologies

Principles governing energy generation. Energy Conversion: Historic Energy Conversion Sequences and Modern Energy Conversion Sequences. Energy Sources and Energy Supply (Pakistan sources). Conversion Efficiencies, overall Efficiency including steps Upstream & downstream of Energy Conversion System. Rate Processes in Energy Conversion. Special current and anticipated future technologies for energy production. Interconversion, storage, exemplified by Gasification to Syngas. Fischer-Tropsch Reaction. Hydrogen economy, Hybrid cars and Renewable energy technologies. Common conversion efficiency challenges.

Recommended Books:

- 1. Energy Technology and Directions for the Future by John R. Fanchi.
- 2. Enhancing the Market Deployment of Energy Technology: A Survey of Eight Technologies by Lea

CAS-ME 508 Thin Films Technology [3CH]

Crystal structures and defects in thin films. The basic nucleation and growth mechanisms of thin films (growth models, lattice matching epitaxy and domain matching epitaxy). Thin film processing techniques (CVD, MOCVD, MBE, PLD, Laser-MBE, sputtering, and evaporation). Thin film growth instrumentation aspect (energy source, chamber configurations, vacuum systems and growth controllers). Advanced topics related to electrical and optical devices. Clean room technology.

Recommended Books:

1. Electronic Thin Film Science for Electrical Engineers & Materials Scientists by K-N Tu, J. W. Mayer and L.C. 2. Materials Science of Thin Films, Deposition and Structure by M. Ohring

CAS-ME 511 Materials Thermodynamics [3CH]

Concepts of Helmholtz Free Energy and Gibbs Free Energy. Energy-Property relationships. Thermal Equilibria, Chemical Equilibria and Ellingham Diagrams. 1st order and 2nd order Transformations. Gibbs Helmholtz Relationships. Fugacity and Chemical activity. Equilibrium constant and its variation with temperature. Vant Hoff's equation. Effect of temperature and pressure on phase transformations. Clapeyron equation. Thermodynamics of solutions using examples of molten salt for energy storage.

Recommended Books:

- 1. Introduction to Thermodynamics of Materials by D. R. Gaskell
- 2. Amendments in Thermodynamics: an Advanced Text for Material Scientists by J. Hudson
- CAS-EP 520 Research Methodology [2CH]

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:

- 1. Investigating the Social World: The Process and Practice of Research, Schutt, R. K. (7th edition). Los Angeles: Sage.
- CAS-EP 521 Management of Technology & Innovation (MOTI) [3CH]

Technology and Competitiveness, Business Strategy and Technology Strategy, The Role of Technology in Creation of Wealth, Critical factors in managing Technology, Management of Technology: The New Paradigms, Technology Life Cycle, The Process of Technology Innovation, Technology Planning, The Acquisition and Exploitation of Technology, Technology Transfer.

Recommended Books:

- Management of Technology (The Key to Competitiveness and Wealth Creation), By Tarek M. Khalil.
- 2. The Management of Technological Innovation Strategy and Practice, Revised Edition, Mark Dodgson, David M. Gann, and Ammon Salter, Oxford University Press.

CAS-EP 522 Technology Entrepreneurship [3CH]

Entrepreneurship and entrepreneurial mind-set, Entrepreneurial intentions and corporate

entrepreneurship, Entrepreneurial Strategy: (Generating and exploiting new entries), Creativity and the business plan, Identifying and analyzing domestic and international opportunities, Protecting the idea and other legal issues for the entrepreneur, The business plan, The marketing plan, The organizational plan, The financial plan, Strategies for growth and managing the implication of growth.

Recommended Book:

- 1. Entrepreneurship by Robert D-Histrich / Micheal P. Peters / Dean A.Shepherd.
- CAS-ME588 Advanced Topics in Energy Storage and Conversion

Advanced topics of current interest in energy storage and conversion. Topics are selected from current technical literature.

CAS-ME 599 Master's Thesis [6CH]

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 32 credit hours (including 26 credit hours of courses and 6 credit hours of research) are required to complete the Master's Degree Programme. The 26 credit hours of course work shall include a minimum of 18 credit hours from the area of specialization and 2 credit hours of the course "Research Methodology". This course will be registered as 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.
 - c) Candidates seeking admission must score 50% minimum marks in GRE General type test, 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 General Type Test conducted by UATA = 50% Weightage

Departmental Subject Test = 50 % Weightage

g) The UATA (GAT General)/UATA (UET GATE Special) tests shall be valid for one academic years while subject test shall be conducted each time admission is offered.

Department	Seats Reserved for Open Merit	Seats Reserved for Rationalized Fees Basis	Total
Electrical Engineering			
Power Engineering	30	10	40
Communication and Electronic Engineering	35	10	45
Civil Engineering			
Water Resources Engineering	22	10	32
Environmental Engineering	22	10	32
Structural Engineering	25	10	35
Geo-Technical Engineering	23	10	33
Transportation Engineering	23	10	33
Earthquake Engineering	20	10	30
Mechanical Engineering			
Dynamics & Control	25	10	35
Mechanical Engineering Design	30	10	40
Materials Engineering	20	20	40
Computer Systems Engineering	35	10	45
Mining Engineering	20	10	30
Agricultural Engineering			
Soil & Water Engineering	20	10	30
Farm Machinery & Power Engineering	15	10	25
Chemical Engineering	25	10	35
Industrial Engineering	35	10	45
Computer Software Engineering	35	10	45
National Institute of Urban Infrastructure Planning (NIUIP)			
Urban Infrastructure Engineering Degree Programme	30	10	40
Urban Infrastructure Planning & Management	25	10	35
Mathematics	35	10	45
Computer Science & Information Technology (CS&IT)	35	10	45
Mechatronics Engineering	35	20	55
Telecommunication Engineering	35	10	45
TOTAL	655	260	915

Table 1: Seat allocation for Pakistani students for Fall 2016 Semester and Spring 2017 Semester

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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.
- 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.
- Admission of any student is liable to be cancelled if his/her academic progress or conduct at any stage is found unsatisfactory.
- 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 in some other institution, is ineligible to apply for admission in this University. 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.
- 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:
 - 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.
- 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:-

- 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.

 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.

S. No.	Item	Pakistani Nationals (Rs.)
1	Registration Fees (per semester)	2000.00
2	Tuition Fee (per credit hours)	3000.00
3	Computer Fund (per semester)	750.00
4	Library Fund Non Refundable (per semester)	1000.00
5	Library & Lab. Security (on first registration) Refundable	4000.00
6	Field Trips (Charged when a field Trip organize)	1000.00
7	Thesis Evaluation Charges (on submission of Thesis)	4000.00
8	Course Completion Certificate	200.00
9	Interim Transcript	200.00
10	Final Transcript	500.00
11	Lab. Charges (per Semester)	2000.00
12	Internet Charges (per semester)	1000.00
13	CMS/PERN Charges (per semester)	2000.00
14	Utility charges (per semester)	2000.00

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:

% of Tuition Fee	Time Line for Semester System
Full (100%) Fee refund	Upto 7 th day of commencement of classes
Half (50%) Fee refund	From 8 th -15 th day of commencement of classes
No Fee (0%) refund	From 16 th day of commencement of classes

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.
- 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. However, this condition shall not be applicable in a semester offering an additional 2-credit hour course on Research Methodology and research thesis / Mini Project.

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.
- 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).
- 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

 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

- The M.Sc research proposal (submitted by a 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.
- 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 eight (08) which will include maximum three (03) 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

4.00
3.67
3.33
3.00
2.67
2.33
2.00
1.67
1.33
1.00
0.00
Incomplete
Withdrawn
Audit
Satisfactory (for thesis only)
Unsatisfactory (for thesis only)

- 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

- 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 32 credit hours (including 6 credit hours of research) are required to complete the Master's Degree Programme. The 26 credit hours of course work shall include a minimum of 6 courses from the core area of specialization and 2 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 Liberary 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.
- 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.
- 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

²²¹ UET Postgraduate Prospectus 2016-17

Cancellation the refund policy is as under:

% of Tuition Fee	Time Line for Semester System
Full (100%) Fee refund	Upto 7 th day of commencement of classes
Half (50%) Fee refund	From 8 th -15 th day of commencement of classes
No Fee (0%) refund	From 16 th day of commencement of classes

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.

 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. Table 4: Fees and other Charges for Rationalized Fees Students

S. No.	ltem	Pakistani Nationals (Rs.)	Foreign Students (US\$)
1	Registration Fees (per semester)	2500.00	90.00
2	Tuition Fee (per credit hours)	6500.00	180.00
3	Computer Fund (per semester)	1500.00	90.00
4	Library Fund Non Refundable (per semester)	2000.00	90.00
5	Library & Lab. Security (on first registration) Refundable	5000.00	400.00
6	Field Trips (Charged when a field Trip organize)	1500.00	90.00
7	Thesis Evaluation Charges (on submission of Thesis)	4000.00	550.00
8	Course Completion Certificate	250.00	10.00
9	Interim Transcript	250.00	10.00
10	Final Transcript	600.00	20.00
11	Lab. Charges (per Semester)	2500.00	21.00
12	Internet Charges (per Semester)	1500.00	21.00
13	CMS/PERN Charges (per semester)	2500.00	21.00
14	Utility charges (per semester)	2500.00	21.00

1.20 Special Provisions

- a) In all cases where regulations are silent, the decisions of the vice-chancellor shall be final.
- All other regulations and instructions relating to Master's Engineering courses issued here-to-fore stand repealed.
- c) 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.

d) Interpretation of these rules and regulations by the authorized officers of the University shall be final.

Rules & Regulations

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 taskoriented 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

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.
- A Ph.D. student may be allowed to register in an advanced Postgraduate course as a single participant with the approval of the Dean.
- 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:
 - 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 32 credit hours out of which 26 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.

- The candidates seeking admission in Ph.D. Programme must have:
 - 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.
 - (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

- 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,
- d) Each member shall submit his report recommending:-
 - (i) That the candidate be declared to have passed the examination, OR
 - (ii) That the candidate should appear for vivavoce, after a period stipulated by the Examination Committee, OR
 - (iii) That the candidate be declared to have failed and ineligible for the award of the Ph.D. degree.
 - (iv) The recommendation made by the majority of the examiners shall be implemented. In case of a tie, the BOASAR shall recommend to the vicechancellor for appointing a neutral examiner whose opinion shall be final.
- e) Acceptance/publication of at least one research paper in an HEC approved journal is essential for the award of Ph.D. degree.
- (f) The candidate shall be admitted to a Ph.D. degree in the relevant branch, provided that

he/she has been declared to have passed the viva-voce examination in accordance with these regulations.

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-4 (Page-211) for Rationalized 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:-

- 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.

- Staging, inciting or participating in any walk-(e) 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.
- 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
- Habitually neglects his work or habitually absents himself from his class without valid reason; or
- Wilfully damages University (or) public property or the property of a fellow student or any teacher or any employee of the University or
- 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.

Conduct & Discipline Regulations

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

- 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 explan-ation 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

- 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

Conduct & Discipline Regulations

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:

S.No	OFFENCE	PENALTY
1.	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.	Debar from classes for one week or fine not exceeding Rs. 10,000/- OR Expulsion from the University.
2.	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.	Stern warning and / or Fine not exceeding Rs. 20,000/-, AND / OR Expulsion from hostel accommodation, if relevant.
3.	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.	All money supposed to have collected shall be confiscated in favour of the University. AND/OR Fine not exceeding Rs. 10,000/-
4.	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.	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/-

5.	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.	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/-
6.	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.	Permanent expulsion from the University. AND / OR Fine not exceeding Rs. 50,000/-
7.	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.	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.
8.	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.	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.

9.	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.
10.	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.
11.	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.
12.	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/-
13.	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/-

Hostel 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, alongwith 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

4

An appeal against the punishment awarded by the Resident Warden shall be forwarded to the Hostel Discipline Committee within fifteen days.

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 imposition of a fine of more than Rs. 40,000/and or expulsion/rustications from the university) to the University Discipline Committee.
- 4.5 The decision of the HDC will be communicated in writing and will be duly signed by all members. The Assistant Provost will be responsible for recording the minutes and decisions of the committee, keeping proper record of all cases, and communication of decisions to all members, concerned students and wardens.

5 APPEAL

5.1 An appeal against the punishment awarded by the Hostel Discipline Committee shall be forwarded to the University Discipline Committee. 5.2 No appeal by student against the decision of the Hostel Discipline Committee shall be entertained unless it is presented within 15 days of the date on which the decision is communicated to him/her.

6. HOSTEL CHARGES

Hostel charges can be changed from time to time by the University authorities. Hostel charges for the year 2013-2014(till further orders) are as follows:-

b) Hostel Fund

Hostel Security (Refundable/adjustable) Rs.5000/-P.A
Gas advance Rs.2000/-P.A
Contingency (Non refundable) Rs.1500/-P.A
Mess Security (Refundable/adjustable) Rs.2000/-P.A
Hostel card& student affidavit Rs.200/-P.A

S.No.	Description of Charges	Amount (Rs.)
a)	University Funds	
1.	Hostel Admission Fee	500.00
2.	Hostel Rent per seat	12000.00
3.	Service Charges	2000.00
4.	Electricity Charges	3000.00
5.	Crockery Funds	500.00
6.	Furniture Funds	500.00
7.	Livery Charges	200.00
b)	Hostel Funds	
10.	Hostel Security (Refundable / Adjustable)	5000.00
2.	Gas Advance	2000.00
3.	Contingency (Non-Refundable)	1500.00
4.	Mess Security (Refundable / Adjustable)	2000.00
5.	Hostel Card & Student Affidavit	200.00

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7 HOSTEL GATES TIMINGS

7.1 Following timings will be observed for boys hostels.

Season	Opening gate Time	Closing gate Time
Winter	7:00 A.M	10:00 P.M
Summer	6:00 A.M	11:00 P.M

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. 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 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.

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.

A: REGULATIONS FOR HOSTEL WARDEN

Hostel Regulations

B: REGULATIONS FOR HOSTEL DISCIPLINE COMMITTEE

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.	
3.	Playing games in hostel lawns and corridors.	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.	

S.No.	Designation	Name	Phone
1	Provost, University Hostels	Engr. Feroz Din	091-9218375
2	Assistant Provost, University Hostels	Mr. Azeem Khan	091-9216505
3	<u>Researchers Hostel Hayatabad</u> Warden	Engr. Zubair Ahamd Khan	091-9217913

Contacts

University of Engineering & Technology, Peshawar (Operator) Ph: (+92-91) 921 6796-98

Prof. Dr. Iftikhar Hussain Vice Chancellor Ph: (+92-91) 921 6493-4 Email: vc@uetpeshawar.edu.pk

Prof. Dr. Noor Mohammad Dean, Faculty of Engineering Ph: (+92-91) 921 6495 E-mail: dean@uetpeshawar.edu.pk

Dr. Khizar Azam Registrar Ph: (+92-91) 921 6496 E-mail: registrar@uetpeshawar.edu.pk

Prof. Dr. M. Haseeb Zafar Secretary BOASAR Ph: (+92-91) 921 6791 boasar@uetpeshawar.edu.pk

Dr. Khan Shahzada Director Postgraduate Studies Ph: (+92-91) 921 6081 khanshahzada@uetpeshawar.edu.pk

Mr. Nek Muhammad Khan Treasurer Ph: (+92-91) 921 6497 E-mail: df@uetpeshawar.edu.pk

Engr. Feroz Din Provost Ph: (+92-91) 921 6502 / 921 6796-98 (Ext. 3036)

Mr. Habib-ur-Rehman Controller of Examinations Ph: (+92-91) 921 6989 E-mail: examination@uetpeshawar.edu.pk

Engr. Iftikhar Ahmad Director Undergraduate Studies Ph: (+92-91) 921 6184 E-mail: engrifti@uetpeshawar.edu.pk

Prof. Dr. Sahar Noor Director, Quality Enhancement Cell Ph: (+92-91) 921 6796-8 E-mail: dirqec@uetpeshawar.edu.pk

Dr. Misbahullah Director Admissions Ph: (+92-91) 921 6784 Email: admission@uetpeshawar.edu.pk Mr. Samiullah Additional Registrar Ph: (+92-91) 921 8224 E-mail: samiullah@uetpeshawar.edu.pk

Mr. Jan Saeed Khan Assistant Director Admissions Ph: (+92-91) 921 6784 Email: admission@uetpeshawar.edu.pk

Mr. Muhammad Ali Sheikh Director Media & Publications Ph: (+92-91) 921 6043 E-mail: dirmedia@uetpeshawar.edu.pk

Manager, IT Centre Ph: (+92-91) 921 8601

Dr. Zia-ul-Haq Advisor Student Affairs E-mail: zia.haq@uetpeshawar.edu.pk Ph: (+92-91) 921 6796-8

Prof. Dr. Afzal Khan Chief Proctor E-mail: afzalkhan@uetpeshawar.edu.pk Ph: (+92-91) 921 6796-8 (Ext. 3067)

Prof. Dr. Afzal Khan Chief Editor, Journal of Engineering & Applied Sciences (JEASE) E-mail: chiefeditor@uetpeshawar.edu.pk Ph: (+92-91) 921 6796-8

Chairmen:

Prof. Dr. Taj Ali Khan Department of Agricultural Engineering Ph: (+92-91) 921 6500 E-mail: chairagri@uetpeshawar.edu.pk

Dr. Muhammad Younas Department of Chemical Engineering Ph: (+92-91) 921 8180 E-mail: m.younas@uetpeshawar.edu.pk

Prof. Dr. Bashir Alam Department of Civil Engineering Ph: (+92-91) 921 6775 Email: chairciv@uetpeshawar.edu.pk

Dr. Laiq Hasan Department of Computer Systems Engineering Ph: (+92-91) 921 6590 E-mail: laiqhasan@uetpeshawar.edu.pk

Prof. Dr. Syed Waqar Shah Department of Electrical Engineering Ph: (+92-91) 921 6498 E-mail: waqar.shah@uetpeshawar.edu.pk Prof. Dr. Sahar Noor Department of Industrial Engineering Ph: (+92-91) 921 6465 E-mail: chairind@uetpeshawar.edu.pk

Prof. Dr. M.Naeem Khan Department of Mechanical Engineering Ph: (+92-91) 921 6499 E-mail: Chairmech@uetpeshawar.edu.pk

Engr. Aman-ul-Mulk Department of Mining Engineering Ph: (+92-91) 921 6501 E-mail: chairmin@uetpeshawar.edu.pk

Prof. Dr. Amjad Ali Department of Basic Sciences & Islamiyat Ph: (+92-91) 921 6502 E-mail: chairbs@uetpeshawar.edu.pk

Dr. Wajeeha Khalil Department of CS & IT Ph: (+92-91) 921 6590 E-mail: wajeeha.khalil@uetpeshawar.edu.pk

Directors:

Prof. Dr. Syed Riaz Akbar Shah Institute of Mechatronics Engineering Ph: (+92-91) 921 7032 E-mail: rasayed@uetpeshawar.edu.pk

Engr. Asif Ali Shah Director CEEC/TIC Ph: (+92-91) 921 7096, 921 7088 E-mail: dirceec@uetpeshawar.edu.pk

Dr. Saeed Gul Director ORIC Ph: (+92-91) 921 8180 E-mail: diroric@uetpeshawar.edu.pk

Dr. Rashid Rehan Director NIUIP Ph: (+92-91) 921 7166 E-mail: dirniuip@uetpeshawar.edu.pk

Engr. Ehtisham Ullah Khan Director Gems & Jewelry Center of Excellence (GJCOE) Ph: (+92-91) 921 6796-8 9 (Ext. 315) E-mail: gdc@uetpeshawar.edu.pk

Prof. Dr. S.M Ali Director Earthquake Engineering Center Ph: (+92-91) 921 8637 E-mail: ali@uetpeshawar.edu.pk

Dr. Haji Faridullah Director Career Development Center Careercenter@uetpeshawar.edu.pk Ph: (+92-91) 921 6796-8

Campuses:

Dr. Muhammad Usman Co-ordinator Mardan Campus Ph: (+92-937) 923 0295 E-mail: cord mardan@uetpeshawar.edu.pk

Contacts

Engr. Siddiqu Akbar Co-ordinator Abbottabad Campus Ph: (+92-992) 381 700 E-mail: siddakbar@uetpeshawar.edu.pk

Dr. Yasir Irfan Badrashi Co-ordinator Bannu Campus Ph: (+92-928) 610 804, 610 636 E-mail: coordinatorbannu@uetpeshawar.edu.pk

Dr. M. Irfan Khattak Co-ordinator Kohat Campus E-mail: m.i.khattak@uetpeshawar.edu.pk Ph: (+92-922) 864 283-4

Dr. Kareem Akhtar Co-ordinator Jalozai Campus Ph: (+92-923) 577 350 E-mail: kareemakhtar@uetpeshawar.edu.pk