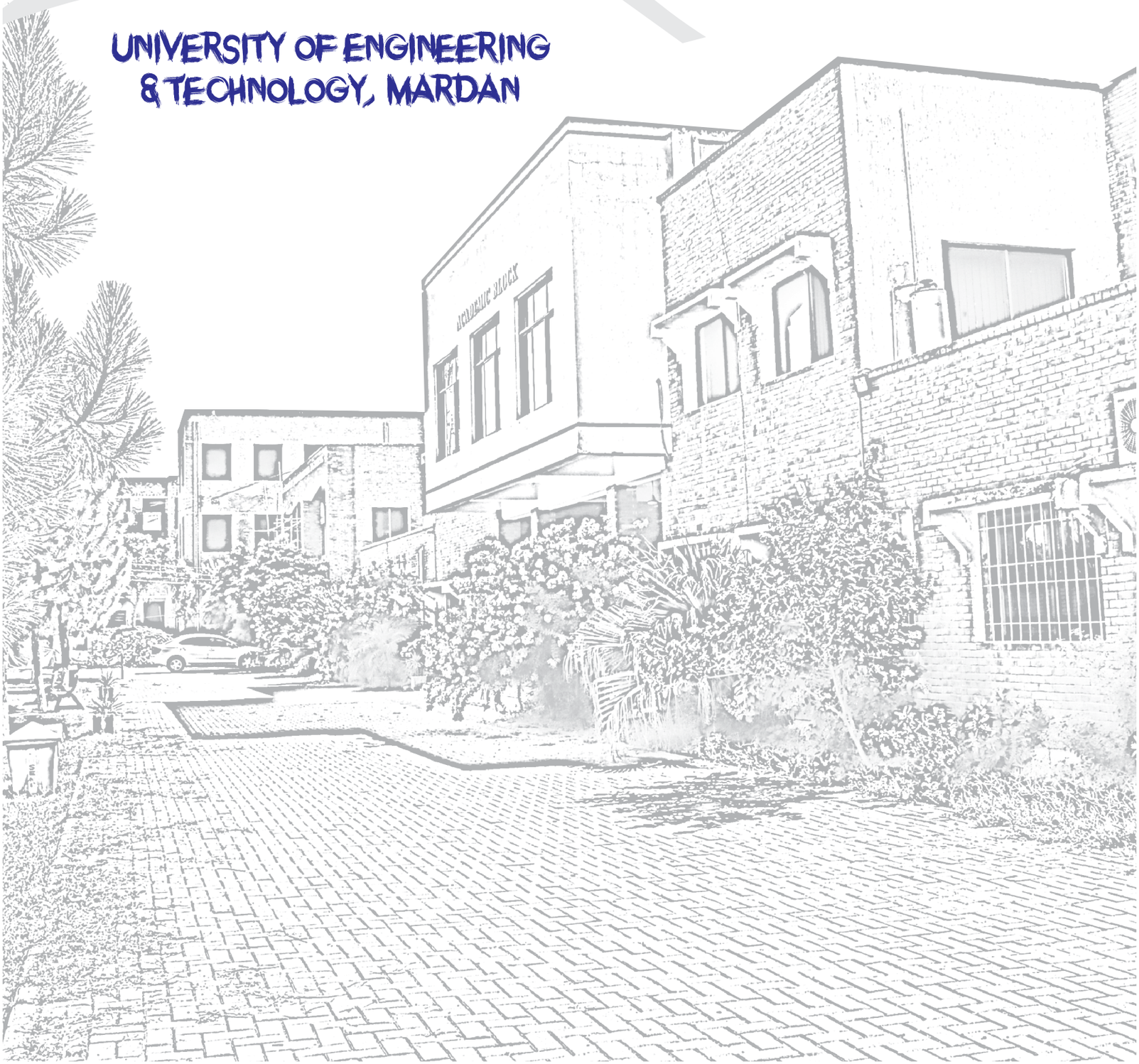
POSTGRADUATE

PROSPECUTS

2020-21

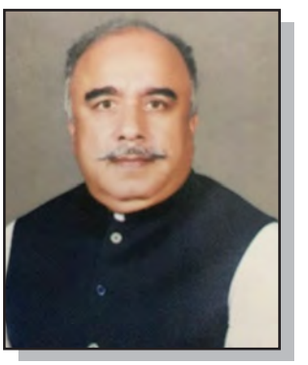
University of Engineering & Technology, Mardan

UNIVERSITY OF ENGINEERING & TECHNOLOGY, MARDAN



CONTENTS

Message of the Chancellor



This is heartening to note that University of Engineering and Technology, Mardan is all set to welcome its third batch of students. In a short period of three years, the university has made a tremendous progress and has emerged as a promising centre of higher education in the field of engineering and computing. Despite being a young university, it was amongst the first few universities of the country to put together all required resources for the online launch of its Spring Semester 2020 amid the chaos of lockdown and Covid-19, also without compromising on the quality of teaching and learning.

For the economic and social uplift, Pakistan needs a highly educated, skilful, technically sound and socially responsible workforce. In pursuance of its stated mission, the university in a few years of time will start contributing to the workforce by graduating its first intake of students. As the transition into the information age speeds up, the graduates trained in the technologies offered by UET Mardan will not only play a major role in solving the problems that our country faces, but will also compete on the global stage. In order to streamline the system, UET Mardan has modernised its labs, invested in acquiring modern educational technologies, and employed highly qualified faculty.

UET Mardan is aware that extra-curricular activities go together with curricular activities, so in order to ensure that students not only gain knowledge and develop skills but are also physically healthy, mentally sound and socially responsible, various extra activities are offered.

While truly appreciating the enormous progress made by UET Mardan over a short span of time, I am looking forward to seeing the university expand its role further. Now that UET Mardan is recruiting its new batch of entrants, I hope and urge that the university administration maintains its spirit of sparing no effort in turning them into highly valuable graduates. I certainly hope that the new batch makes the most of the opportunities and facilities offered by UET Mardan.

Mr. Shah Farman
Governor Khyber Pakhtunkhwa

MESSAGE OF THE VICE CHANCELLOR

Dear
Students and Visitors,

Welcome to University of Engineering and Technology, Mardan, and thank you for taking the time to learn about us. UET Mardan community is centered on our student's success, providing them with a conducive learning environment, exceptional experiences, wealth of knowledge and market-oriented skill set in order to have successful careers.

UET Mardan is strategically located within easy access to both national and provincial capitals and having proximity to the industrial hub of the province. This not only allows our students to be at the forefront of any new developments in education and technology but also enables them to apply their engineering knowledge to the industrial problems. The exceptional experiences at UETM helps our students to grow, develop, explore, apply their knowledge and in the process realize their true potential.

The core missions of UET Mardan university are education, research, and social contribution. Our education system is student learning oriented, with outcome-based learning fully implemented in all the engineering programs. During the recent COVID-19 pandemic, we have evolved to online education which has been ranked among the top universities in Pakistan by the HEC. We are also developing a blended education system which enables our students to access the university facilities without compromising their safety. Through a mixture of class learning, seminars and participation in student societies, we hope to develop well-rounded competent engineers instilled with right values, who are an asset to this region and our country. For research new graduate programs have been added, ORIC is empowered, and scholarships are introduced to attract the best student minds. We intend to contribute to the society around us by promoting free thinking, solving local problems, educating the masses and working closely with the industry. Initiatives have been planned on all these fronts and we hope to be the catalyst for positive changes in our society.

Our website has many resources for you to learn, however, I encourage you to visit our beautiful campus, meet our students and faculty and see for your self the opportunities, activities and facilities that University and Engineering and Technology Mardan offers.

With best Regards

Prof. Dr. Shahid Khattak,
Vice Chancellor,
UET Mardan

MARDAN

Mardan is the second largest city of Khyber Pakhtunkhwa. It has different population segments and tribes from all over Pakistan, and is the de-facto headquarter of the most hospitable and soft-spoken tribe of Pakhtun: Yousafzai. The city is located at the gateway of Northern Areas of Pakistan and has a great geographical significance. Mardan also happens to be the stopping and refreshment spot for all the tourists around the country as it connects places like Swat, Dir, Chitral, and Gilgit. Furthermore, with its central geographic location, the M1 motorway connects it to Peshawar (65 km approx.) and Islamabad (144 km approx.).

Mardan is located in a region rich in archaeological sites and has a long rich history that can be back dated to thousands of years. The oldest of artefacts like the Sanghao Caves, Ashoka remains, excavation sites like Jamal Garhi and Shabaz Ghari are around in Mardan which are a testament to the rich culture and historical importance of this region. Furthermore, the UNESCO World Heritage Site of Takht-i-Bahi is also in its close proximity. Besides, The Mardan Museum: A repository and showcase of the artefacts is just at a walking distance from the University of Engineering and Technology, Mardan.

Additionally, Mardan is a perfect blend of traditional and urban life style with a population of around 2.5 million, it is expanding fast and so are the businesses and markets. On one hand, the people of Mardan get to enjoy the traditional markets like: Gaju Khan Market, Ghareeb Market and Bank-Road, on the other hand, it also offers mega-malls and mega-marts for the shopping spree of its people. It has a variety of continental and traditional food and can satiate all types of palates with its traditional restaurants, modern cafes and road-side vendors that serve mouth-watering food.

Recently, the main Nowshehra-Mardan road has been transformed into a business hub with large shopping malls, food courts and plazas and is yet in the process of development and growth. It also offers health facilities, sports facilities and world-class education facilities. Mardan city is home to Oil mills, Sugar mills, Textile, Tobacco and Marble industry which makes it an industrial zone also.

Mardan City is home to one of the largest regiments of Pakistan Army, and the Punjab Regimental Centre lies at the heart of the city. The city is also a neighbour to Risalpur, the home of Pakistan Air Force, and forms a close proximity with the China and Pakistan Economic Corridor (CPEC) city: Rashakai, which can in future, provide industrial opportunities and economic growth.

About **UET** MARDAN

UET Mardan is the emerging public sector engineering university in the Khyber Pakhtunkhwa recognised by HEC. It aims to provide quality engineering education to the people of Khyber Pakhtunkhwa. It is an inspiring place to work & study with the continuous flow of new knowledge and ideas.
The key features of the system running at UET Mardan are:

Outcome Based Education System:
Outcome Based Education system in line with the Washington Accord.

Quality Enhancement Cell:
Quality Enhancement Cell undertakes measures for ensuring academic quality assessment & enhancement and to assist in implementing Internal Quality Assurance (IQA).

Office of Research, Innovation & Commercialisation:
Office of Research, Innovation & Commercialisation serves as a pivotal point, encompassing all the research activities-from development of research proposals to commercialisation of research products.
UET Mardan facilitates the students with its best by providing:

Career Counselling:
The students of UET, Mardan get innumerable counsellors for academic and educational plans who help them shape their goals and objectives. The counsellors are easily accessible for advice on career choice, prospect employers, future market trends, and internships and these career guides also impart and generate knowledge from their expertise.

Digital Access:
Internet Access provision in each department.

Libraries:
Equipped with books that can meet the requirement of each discipline. It has digital Library and also a Post-Graduate room for research and study.

Laboratories:
We soar a fleet of 24 plus laboratories, these fully equipped state-of-the-art laboratories include: 9 labs at Department of Telecommunication Engineering, 9 labs at Department of Electrical Engineering, 6 labs at Department of Computer Software Engineering & 2 labs at the Department of Computer Science. These labs include Radar Labs, Solaris Labs, Advance Electronics Labs, Programming Lab, Data Science Lab, System and Design Lab, Final Year Project Labs, Postgraduate Lab, Embedded Systems Lab, Power Generation, Transmission and Distribution Analysis Labs, Advance Machinery Lab, Computer Labs, Communication Labs, Control Systems Labs, Advance Telephony and Various types of experimentation test beds as well as workshops.

Scholarships and Financial Aid:
Various scholarships are available to the deserving students. These include the University's Freeships and Merit Scholarships to the students in each program.
Disciplines: There are three major disciplines of engineering: Telecommunication Engineering, Electrical Engineering and Computer Software Engineering. Besides, a Department of Computer Science has also been introduced in the year 2018. The plans are bigger for the coming time and it will be an ongoing effort for its people so that they can chase their dreams and make them a reality. Furthermore, much more avenues and platforms will be made open for the people who have different engineering potential and interests. We are also working towards introducing some new disciplines like Computer Systems Engineering, Mechanical Engineering, Civil Engineering, and Chemical Engineering at UET Mardan in the years to come. In essence, the aim is to work for excellence and finesse, and make a world-class production.

General:
UET Mardan, spreading over an area of 172 Kanals, is providing quality education as well as environment to the masses. There are on-campus residence of staff and faculty, two boy's hostels and one girls hostel that are situated as purpose buildings inside campus with dedicated official caretakers as well as management staff. We have football grounds, cricket ground, basketball court, badminton courts besides indoor sports and hostel TV lounges that are necessary for the mental as well as physical health of our students.
Moreover, the institute is surrounded by the agricultural lands of Mardan as well as the developed city and buildings so students have an easy access to most of the outside university facilities as well. We have assured the timely response in emergency situations by providing 24/7 on duty medical staff and a dedicated ambulance. The university is a safe haven that provides engineering knowledge, fresh environment as well as community awareness besides uplifting the province from its geographical centre.

University Governance:

Senate, Syndicate and Academic Council are the three main governing bodies of UET Mardan. The compositions of which are given in the following sections.SenateThe Senate is the highest statutory body of the University and has the power of general supervision over the University. The Senate has all powers of the University not expressly vested in an Authority or Officer by Khyber Pakhtunkhwa Universities Act 2012 (amended 2018) and all other powers not expressly mentioned in the Act that are necessary for the performance of its functions. The Senate consists of the following:

1The Chancellor, who shall be its Chairperson2The Pro-Chancellor3The Vice Chancellor4One member of the Provincial Assembly of the Khyber Pakhtunkhwa to be nominated by the Speaker of the said Assembly.5A retired judge to be nominated by Chief Justice of Peshawar High Court.6Secretary of the relevant Administrative Department of Govt. or his nominee not below the rank of an Additional Secretary.7The Secretary to Government, Higher Education Department, or his nominee not below the rank of an Additional Secretary.8The Secretary to Government, Finance Department, or his nominee not below the rank of an Additional Secretary.9The Secretary to Government, Establishment Department, or his nominee not below the rank of an Additional Secretary.10The Chairman, Higher Education Commission or his nominee not below the rank of Director General.11One eminent or distinguished graduates of the University who are not its employees to be nominated by the Chancellor.12Two persons from the academic community of the Province of the Khyber Pakhtunkhwa or the country, other than an employee of the University, at the level of professor or Principal, to be appointed by the Chancellor.13Four University Teachers, including one Professor, one Associate Professor, one Assistant Professor and one Lecturer to be elected by teachers of their respective cadres from amongst themselves.14Four persons from society at large being persons of distinction in the fields of administration, management, education, academics, law, accountancy, medicine, fine arts, architecture, industry, agriculture, science, technology and engineering with a view to create diversity and balance across the various fields, to be nominated by the Chancellor.15One University Administrative Officer to be elected from amongst all the Administrative Officers in the prescribed manner.

Syndicate:

1. The Vice Chancellor, who shall be its Chairperson
2. A retired judge to be nominated by Chief Justice of Peshawar High Court
3. The Dean of the faculty of Engineering of the University
4. Secretary of the relevant administrative Department or his nominee not below the rank of an Additional Secretary.
5. The Secretary to Government, Higher Education Department, or his nominee not below the rank of a Deputy Secretary.
6. The Secretary to Government, Establishment Department, or his nominee not below the rank of Additional Secretary.
7. The Secretary to Government, Finance Department, or his nominee not below the rank of Additional Secretary.
8. Two Principals (preferably one male and one female) of affiliated colleges to be nominated by the Academic Council
9. One Professor, One Associate Professor, One Assistant Professor and one Lecturer of the University to be elected by teachers of their respective cadres in the manner as may be prescribed by Statutes.
10. One Principal or Chairman or Director of the Teaching Department or Institute or Centre to be elected from amongst themselves in accordance with the prescribed Statutes.
11. One administrative officer to be elected from amongst themselves in a manner as may be prescribed by Statutes.
12. Registrar
13. Treasurer
14. One nominee of the Commission not below the rank of an advisor or member.
15. One person of eminence to be nominated by the Chancellor.
16. Two University Administrative Officers to be elected from amongst all the Administrative Officers in the prescribed manner.

Academic Council:

The Academic Council is the principal academic body of the University, subject to provisions of the Act-2016 and the statutes, has the powers to lay down proper standards of instruction, research and examinations and to regulate and promote the academic life of the University. The Academic Council consists of the following:

1. The Vice Chancellor, who shall be its Chairperson
2. The Chairpersons of Teaching Departments or Directors of academic institutes/units
3. The Deans
4. All Professors including Emeritus and Meritorious Professors
5. Six University teachers including two Associate Professors, two Assistant Professors and two lecturers to be elected from amongst themselves in the manner prescribed by Statutes.
6. Two Principals, preferably one female, of affiliated colleges, one each from public and private sector, to be nominated by the relevant administrative Secretary of the Government department.
7. One Principal of the constituent college, to be nominated by the Senate.
8. The Director Admissions
9. The Controller of Examinations
10. The Registrar, who shall be its member-cum-secretary

UNIVERSITY *of* ENGINEERING & TECHNOLOGY, MARDAN

Department of Computer Software Engineering

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. Software Engineering encompasses the entire software process, i.e., 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.

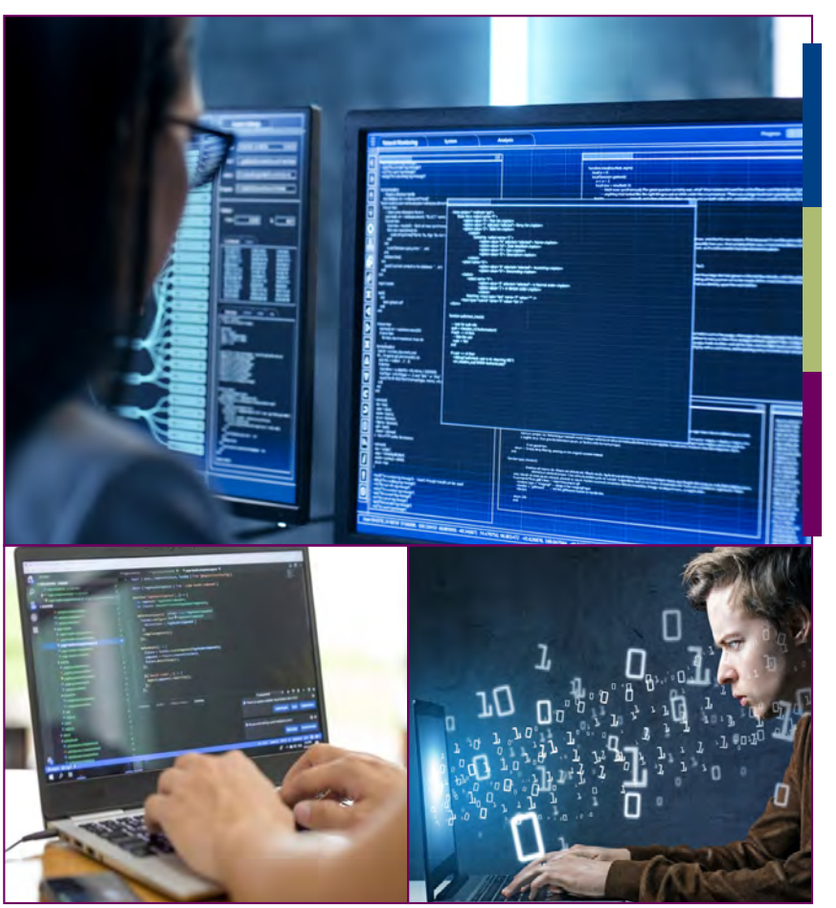
The postgraduate program in Computer Software Engineering was started in spring 2011 in the then Mardan Campus of UET Peshawar. Currently, the department of Computer Software Engineering offers B.Sc., M.Sc. and Ph.D. degrees. The postgraduate program is designed to develop professional skills, expertise in software development and management of software technology. The program accommodates both working professionals and fresh graduates. 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, machine learning, artificial intelligence, and computer networks.

DEPARTMENT MISSION

The mission of this program is to equip students with the concepts, techniques, skills and tools for the design & development of medium and large scale software systems. To prepare graduates for professional careers in software industry, academia and research organizations by imparting them life-long learning capabilities.

WHY YOU SHOULD STUDY MSc. OR Ph.D in SOFTWARE ENGINEERING?

According to United States Bureau of Labor and Statistics, Software Engineers are amongst the highly paid professionals. Software Engineering produces entrepreneurs who help the Government in creating job opportunities, developers who build products/solutions from minimum viable to large scale, and researchers who contribute by creation of new knowledge and propose solutions to challenges



faced by the practitioners and researchers of the discipline. Start-ups are agents of change that bring in innovations and find solutions to problems at various scales. Software Engineering forms the basis for digital transformation and digital/ knowledge economy.

RESEARCH AVENUES

The Department of Computer Software Engineering conducts research in the following areas:

- Machine Learning
- Software Testing
- Software Requirements Engineering
- Software Design & Architecture
- Agile Software Development
- Global Software Development
- Software Outsourcing
- Data Science
- Internet of Things
- Semantic Web
- Software Ontology
- Human Computer Interaction

LECTURERS

- Engr. Muhammad Ishaq
  MSc (Pak)
- Engr. Fahim Ullah Khan
  MSc (Pak)
- Engr. Zafar Ali Shah
  MSc (Pak)- On study leave
- Engr. Shaharyar
  MSc (Pak)
- Engr. Lubna Gul
  MSc (Pak)
- Engr. Shabir Ahmad
  Msc (Pak)-On study leave

FACULTY

CHAIRMAN

- Prof. Dr. Ibrar Ali Shah — PhD (UK)

ADVISOR POSTGRADUATE STUDIES

- Dr. Muhammad Usman — PhD (South Korea)

PROFESSORS

- Prof. Dr. Sadaqat Jan — PhD (UK)
- Prof. Dr. Ibrar Ali Shah — PhD (UK)

ASSOCIATE PROFESSORS

- Dr. Muhammad Usman — PhD (South Korea)

ASSISTANT PROFESSORS

- Dr. Muhammad Sohail Khan — PhD (South Korea)
- Engr. Imran Maqsood — MSc (Pak)

Eligibility Criteria for Admission in MSc Computer Software Engineering

1. BS/BSc. Computer Software Engineering/ BS (CS) 16 years of education.

   OR

   Computer Science Conversion course two years degree program (16 years of education) referred to as MCS or M.Sc. Computer Science.

   OR

   Sixteen years education in relevant engineering program: Under this eligibility criterion, the candidates will be required to complete the deficiency coursework prior to the MSc. Computer Software Engineering course work to ensure the pre-requisite competency in Software Engineering. The deficiency coursework will be determined based on the core Software Engineering courses of the BSc. Software Engineering degree.
2. Must have earned CGPA (Cumulative Grade Point Average) of at least 2.0 (on the scale of 4.0) or 60% marks where CGPA is not applicable.

COURSES

A. List of Core Courses

Following is the list of mandatory courses. Students are required to study and pass the following *three (03)* courses in the Core Courses Domain:

S.No.	Course Title	Course Title	Credit Hours
1.	SE-5901	Advanced Software System Architecture	3
2.	SE5902	Advanced Requirements Engineering	3
3.	SE-5903	Software Testing and Quality Assurance	3

B. List of Elective Courses

Students are required to study and pass any five (05) courses from the list of electives in proportion mentioned in each category below:

i. List of Domain Elective Courses

Students are required to study and pass any ***two (02)*** courses from the following Domain Elective Courses:

S.No.	Course Title	Course Title	Credit Hours
1.	SE-5904	Advanced Software Project Management	3
2.	SE5905	Software Measurement and Metrics	3
3.	SE-5906	Component Based Software Engineering	3
4.	SE-5908	Empirical Software Engineering	3
5.	SE-5914	Agile Software Development Methods	3
6.	SE-5916	Advanced Formal Methods	3
7.	SE-5925	Advanced Human-Computer Interaction	3

ii. List of General Elective Courses

Students are required to study and pass any ***three (03)*** courses from the following General Elective Courses:

S.No.	Course Title	Course Title	Credit Hours
1.	SE-5907	Software Configuration Management	3
2.	SE-5909	Intelligent System Design	3
3.	SE-5910	Software Design Patterns	3
4.	SE-5911	Bio-Inspired Computation	3
5.	SE-5912	Software Risk Management	3
6.	SE-5913	Research Methods	3
7.	SE-5915	Advanced Web Engineering	3
8.	SE-5917	Software Engineering Ontology	3
9.	SE-5918	Semantic Web Enabled Software Engineering	3
10.	SE-5919	Model Driven Software Development	3
11.	SE-5920	Machine Learning Application in Software Engineering	3
12.	SE-5921	Software Case Tools & Applications	3
13.	SE-5922	Information System Security	3
14.	SE-5923	Design and Analysis of Network System	3

S.No.	Course Title	Course Title	Credit Hours
15.	SE-5924	Data Warehousing	3
16.	SE-5927	Reliability Engineering	3
17.	SE-5928	Complex Networks	3
18.	SE-5929	Agent Based Modeling	3
19.	SE-5930	Data Mining	3
20.	SE-5931	Internet of Things	3
21.	SE-5926	Special Topic Related to Software Engineering	3

c. Master's Thesis

S.No.	Course Title	Course Title	Credit Hours
1.	SE-5999	Master's Thesis	6

Course Contents:

SE-5901 Advanced Software System Architecture

Quality attributes in the context of architecting. Qualitative and quantitative assessment of architectures. Architectural modeling through Architecture Description Languages. System modeling its relation to software architecting. Architecting for evolution and variability. Partitioned and layered architectures. System-of-Systems and Ultra-Large Scale Systems. Software Product Lines and Configurable Software. Self-Adaptive Software. Architectural Description Languages. Feature Modeling. Architecture and Model-Based Testing. Current research topics in software system architecture.

SE-5902 Advanced Requirements Engineering

Software Requirements Fundamentals: Product and process requirements, Functional and non-functional requirements, Emergent properties, Quantifiable requirements, System and software requirements. Requirements Process: Process models, Process actors, Process support and management, Process quality and improvement. Requirements Analysis: Requirements sources, Elicitation techniques. Requirements Analysis: Requirements classification, Conceptual modeling, Architectural design and requirements allocation, Requirements negotiation, Formal analysis. Requirements Specification: System definition document, System requirements document,

Validation: Requirements reviews, Prototyping, Model validation, Acceptance tests. Practical Considerations: Iterative nature of the requirements process, Change management, Requirements attributes, Requirements tracing, Measuring requirements. Software Requirements Tools. Current research topics in requirement engineering.

SE-5903 Software Testing and Quality Assurance

Testing techniques. Black Box testing, White Box and Grey Box testing techniques. Quality Assurance planning and execution. Automated testing topics include constructing a framework, scripting techniques, generating a test data, generating test architecture, pre/post-processing, test maintenance, and job specific metrics. Current research topics in Software Testing and Quality Assurance.

SE-5904 Advanced Software Project Management

Introduction to project management. Algorithmic cost estimation models. Advanced cost estimation models. Function points estimation Risk assessment. Life cycle models. Prototyping. Management of software reuse. Software maintenance. Software maturity framework. An Overview of Project Planning. Program Management and Project Evaluation. Software Effort Estimation. Activity Planning. Risk Analysis and Management. Resource Allocation. Project tracking and Control. Contract Management. Software Quality Assurance. Configuration Management. Various tools of Software Project Management. Project Cost Management. Project Human Resource Management. Project Communications Management. Project Procurement Management. Case studies, Current research topics in Software Project Management.

SE-5905 Software Measurement and Metrics

Introduction to quality control and planning needs (Measurement Concepts, Measurement as a support process, Review Metrics Models and Standards). Measurement goals (Formulating problem and goal statement, prioritize information needs and objectives, Formalize measurement goals). Specify Measures (Identify questions and indicators, Identify data elements, Operational definitions for measures). Specify Data Collection and Storage Procedures. Sources of data. How to collect and store the measurement data? Specify Analysis Procedures. Potential data analyses. Methods and tools for measuring software. Develop software measurement reporting. Current research topics in Software Measurement and Metrics.

SE-5906 Component Based Software Engineering

Introduction to Software Component (Component. Definition and Essentials, what is CBSE? Why CBSE? The Anatomy of Components: internals, application interfaces, platform interfaces, middleware, Component Characteristics: Properties of Software Component in CBSE). Basic Concepts in CBSE (Improving SW through Software Process Improvement (SPI)), Component-Based Software Development (CBSD). Approach. Component Patterns & Abstraction. Challenges of CBSE. Technical Issues and Objectives of Component Based Software Engineering. Reuse Dimensions. Software Components Types: open, closed, COTS, in house. Challenges in Software Reuse. Software Component Specification. Specification Techniques. Specifying the Semantics of Components. Specifying Extra-Functional Properties. Architecting component based systems (Software Architecture Parts, The Roles of Software Architecture, Designing Software Architectures, Architectural Styles, Architecture-Driven Component Development, Components and Component Models, Component Model Implementation, Component Frameworks, Black-Box and White-Box Frameworks, how do we use Framework in CBSE? Component Interface Specification). Component Engineering Process: Domain Engineering, Domain Engineering pattern based design. Domain Engineering: Component Repositories, Overview of Existing Component Techniques, Component testing in CBSE. Current research topics in Component Based Software Engineering.

SE-9508 Empirical Software Engineering

Quantitative study design. Qualitative study designs. Measurement and data collection. State-of-the practice. Archival data analysis. Human variation & impact of experience. Evidence-based software engineering. Simulation of software process. Current research techniques in Empirical Software

Engineering.

SE-5914 Agile Software Development Methods

Agile values and principles. Agile Practices. Pair programming Refactoring. Test-driven development. Continuous integration and delivery. Automated build. Coding standards simplicity. SMART user stories and release and deployment. Applying Agile methods: Integration, XP+SCRUM, SCRUM +Kanban, Agile methods +User-Centered Design. Distributed Agile teams. Current research topics in Agile Software Development.

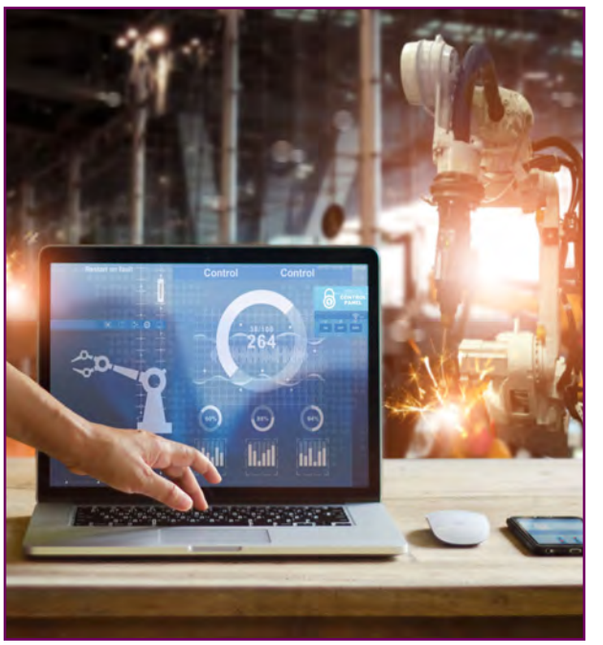
SE-5916 Advanced Formal Methods

Introduction to formal methods and specification. State-Based Formal Methods. Transformational systems. Traditional approaches. Z specification. Formal development cycle. Temporal Specification: reactive systems, syntax and semantics of temporal logic, temporal specification of reactive systems (safety, aliveness, fairness). Model Checking: Generating finite models, Analysis of a simple model checking algorithm. Symbolic model checking. Overview of reduction methods. Spin and Promela. Case study and practical verification of properties. Current research topics based on Formal Methods.

SE-5925 Advance Human-Computer Interaction

Introduction to HCI. Importance of usable and useful software products. The theories of HCI. How to evaluate/develop software products. How to apply theoretical results from HCI research to software products. How to conduct their own research about aspects of usability and user experience, Concepts of Human Computer Interaction. The psychology of usable things. Usability Engineering. Prototypes. Usability inspection methods. Usability testing methods. Usability in practice. User Experience (UX). Web Usability. Mobile Usability. Mobile User Experience. Site objectives and user needs. Information architecture. Information and navigation design. Implementation and optimization. Experiments and HCI guidelines. Current research topics in Human-Computer Interaction.

SE-5907 Software Configuration



Management

Management of the SCM Process. Organizational Context for SCM. Constraints and Guidance for the SCM Process. Planning for SCM. SCM Plan. Surveillance of Software Configuration Management. Software Configuration Identification. Identifying Items to Be Controlled. Software Library. Software Configuration Control. Requesting, Evaluating, and Approving Software Changes. Implementing Software Changes. Deviations and Waivers. Software Configuration Status Accounting. Software Configuration Status Information. Software Configuration Status Reporting. Software Configuration Auditing. Software Functional Configuration Audit. Software Physical Configuration Audit. In-process Audits of a Software Baseline. Software Release Management and Delivery. Software Building. Software Release Management. Software Configuration Management Tools. Current research topics in Software Configuration Management.

SE-5909 Intelligent System Design

Introduction to Intelligent Systems, Adaptation, Learning, Memory Development, Instinctive Behavior, 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 dependent plasticity networks, Neuro-Evolution, Topology and Weight evolutionary ANNs), Neuro-evolution of Augmented topologies, Neural development.

SE-5910 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.

SE-5911 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, Co-evolution, Evolutionary Development.

SE-5912 Software Risk Management

What is risk and risk management? Motivation for risk management. Reasons we don't do risk management. SEI's Risk Management paradigm. Identifying and recording software risk. Risk Taxonomy. Tools and methods for identifying and recording risks. Analyzing and classifying risks. Complex project management theory. Software Risk Identification. Software Risk Analysis. Software Risk Planning. Software Risk Monitoring. Software Qualitative Risk Analysis. Quantitative Risk Analysis. Risk management and the SDLC. Risk management in CMM. Other useful tools for successful risk management. Current research topics in Software Risk Management.

SE-5913 Research Methods

Introduction to Research. Objectives of Research. Importance of Research Methodology in Research Study. Types of Research. Steps in Conducting Research. What is Literature Review? Need of Literature Review. Types of Literature Review. Systematic Literature Review Protocol. Problem Statement and Problem formulation. Criteria for selecting a problem. Identifying Types of variables in Research. Types of hypothesis. Identifying Target Population. Types of Sampling. Sampling Techniques. Quantitative Research Methods. Scientific Methods. Design of Quantitative Surveys. Techniques to Conduct Quantitative Methods. Introduction to Qualitative Research. Qualitative Research Methods. Data Analysis and Theory in Qualitative Research Articles. Introduction to Mixed Methods Research. Design of Mixed Methods Research. Evaluation of Mixed Methods Research. Case Study. How to Conduct a Case Study. Case Study Protocol. Importance and Benefits of Case Study. Types of Statistical Tests to Conduct Data Analysis. Data Analysis Tools. Introduction to SPSS. Hands on Practice of SPSS. How to Define variables in SPSS. How to Record Collected Data in SPSS. Types of Tests via SPSS including Regression. Correlation. Cross tabulation and others. How to write Good Research Proposal. Contents of Thesis. Important Elements of Research Thesis.

SE-5915 Advanced 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.

SE-5917 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.

SE-5918 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.

SE-5919 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.

SE-5920 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.

SE-5921 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.

SE-5922 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, Biometrics, TEMPEST, Student final project "presentations".

SE-5923 Design and Analysis of Network Systems

Basic Concepts in Networking Protocols and Layers, process to process lifetime of a packet in network, 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.

SE-5924 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 de-normalizations, horizontal and vertical partitioning, materialized views, Physical design, Data mart design, web data warehousing. Current topics in data warehousing.

SE-5927 Reliability Engineering

Introduction to Reliability Engineering. The Need for Reliable Software. Software Reliability Engineering Concepts. Basic Definitions. Software Reliability and System Reliability. The Dependability Concept. Reliability Modeling. Availability Modeling.

Statistical Reliability Models for Software Reliability. Best Current Practices of software Reliability Engineering. Software Metrics for Reliability Assessment. Software Testing and Reliability. Software Reliability Tools. Review of Reliability Theory. Analytical Techniques and Basic Statistics for Reliability Engineering. Current research topics in Reliability Engineering.

SE-5928 Complex Networks

Introduction to complex networks. What is a complex system? Basic metrics. Degree distribution (DD).Clustering coefficient (CC). Centrality. Page Rank. Hubs and authorities. Bib-coupling. Co-citation index. Edge reciprocity. Rich club phenomenon. Social Network. Homophily. Cohesiveness. Equivalence of ties. Ego-centric networks. Community Structures. Hierarchical Agglomerative. Linear algebra techniques and spectral methods. Citation Networks, Rise and fall of CS fields. Inter-disciplinarily of CS fields. Temporal structures of citation profiles. Citation count prediction. Co-authorship circles. Economic and financial network analytics. Graph mining. Measuring user engagement. Basic definitions and metrics: walks, paths, cycles, connectedness, trees. The clustering coefficient. The World Wide Web. Scale-free networks. Random graphs with a given degree sequence. The Barabasi-Albert model and other models of growing graphs. Degree correlations. The Internet and other assortative and dissertated networks. Community structures: spectral bisection and hierarchical clustering methods. The modularity and Girvan-Newman algorithm. Current research topics in Complex Networks.

SE-5929 Agent Based Modeling

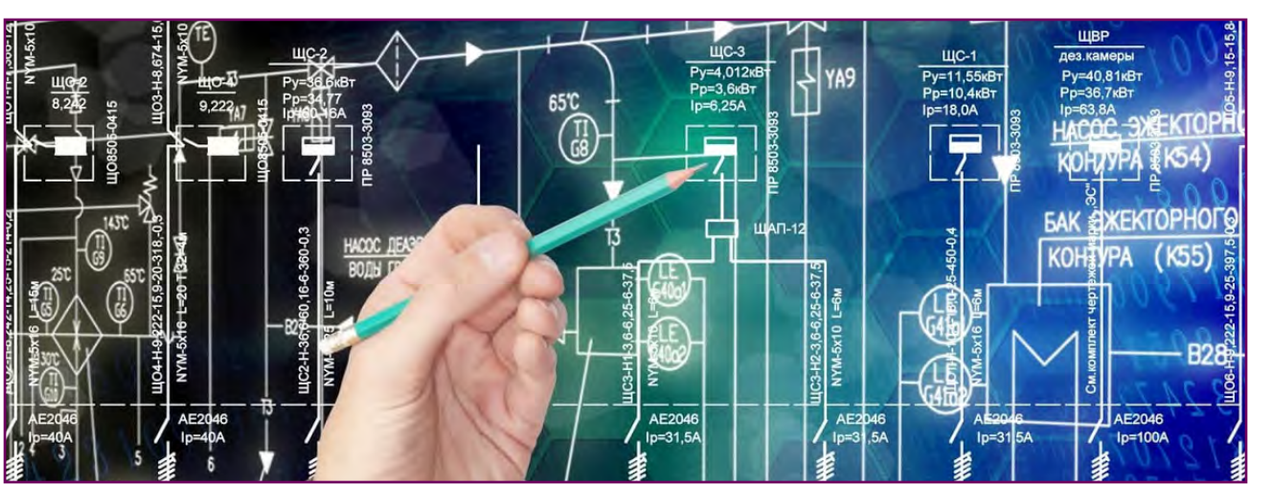
Introduction to agent based modeling. Introduction to Net Logo. Complexity in Social Worlds. Net Logo Commands. Net Logo Procedures. Model properties (Why agent-based objects? Agents, environments, and timescales). Biological systems: fireflies, flocking, slime mold, bees, ants (flocking behavior slime mold).Biological systems: predator/prey, debugging (Verification and validation).Social systems: segregation, Schelling, Micro motives and Macro behavior. A self-forming neighborhood model. Cellular automata. Critical phenomena. Sand piles. Current research topics in Agent Based Modeling.

SE-5930 Data Mining

Introduction: Machine Learning and Data Mining, Data Flood, Data Mining Application Examples, Machine Learning and Classification Examples, Input: Concepts, instances, attributes, Preparing the data, Decision tables, Decision trees, Decision rules, Rules involving relations, Instance-based representation. Classification - Basic methods, Decision Trees , Handling Numeric Attributes , Finding Best Split, Dealing with Missing Values, Pruning , Pre-pruning, Post-Pruning, Estimating Error Rates, From Trees to Rules, Regression, Evaluation and Credibility, Data understanding, Discretization, False predictors , Feature reduction, Randomization, Learning with unbalanced data, Clustering, Associations, Visualization, Summarization and Deviation Detection, Predicting Performance, Bootstrap, Choosing a Loss Function.

SE-5931 Internet of Things

Internet of Things Promises–Definition– Scope–for



IoT Applications, Structure of IoT– Introduction to Cloud, Edge and Fog Computing. IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Basic Electrical and Electronics Concepts, Devices-> Most common Sensors and Actuators. Discussion on current applications of IoT vision, Most common platforms i.e. ThingSpeak, AndroidThings, Xively, Samsara, etc. IoT development platform such as Arduino, Edison & Raspberry PI. Characteristics, Architecture, Sensing & Actuating devices and Programming tutorials. Implementations using Arduino platform and completion of a term project based on IoT applications.

SE-6901 Service Oriented Software Architecture

Introduction to Service-Oriented Architecture, Service Principles, Web Systems Evolution, Web Systems Architecture, HTML / XML / JSON, HTTP, JavaScript, Remote Procedure Call (RPC), Object Brokers. Introduction to Web Services, Service Invocation (SOAP), Service Description (WSDL), Service Publication and Discovery (UDDI), Service Composition (BPEL), RESTful Web Services, Introduction to REST, designing a REST Service, Micro-services, Cloud Services, Security of cloud services, Secure data handling & Avoiding Injection Attacks, Applications of Service Oriented Architecture, Software as a service (Saas), Infrastructure as a Service (Iaas), Platform as a service (Paas), Iaas vs Paas. New trends in Service Oriented Architecture.

SE-6902 Cyber-Physical Systems

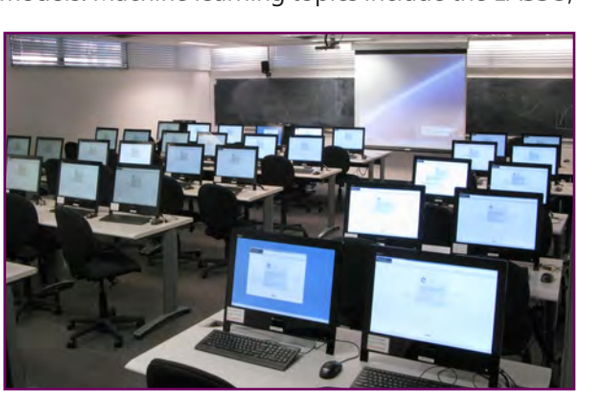
Modeling Cyber-Physical Systems, Discrete-Time Systems Concepts, Continuous-Time Concepts, Continuous-Time Model of Linear Time-Invariant Systems, Modeling Cyber Components: Finite State Machines, Computations, Algorithms, Sample Cyber-Physical System Models, Modeling Interfaces for Cyber-Physical Systems: Conversion, Networks, and Complete CPS Models, Analog to Digital Conversion, Digital to Analog Conversion, Simulation of an Analog to Digital Converter, Modeling an Implemented Finite-State Machine, Simulating an Implemented Finite State Machine, Trajectories in CPS and Simulations: Time Domains, Executions, and Complete CPS Models, CPS and Context aware applications, IoT implementations, RFID systems, Wireless Sensor Network Architecture,

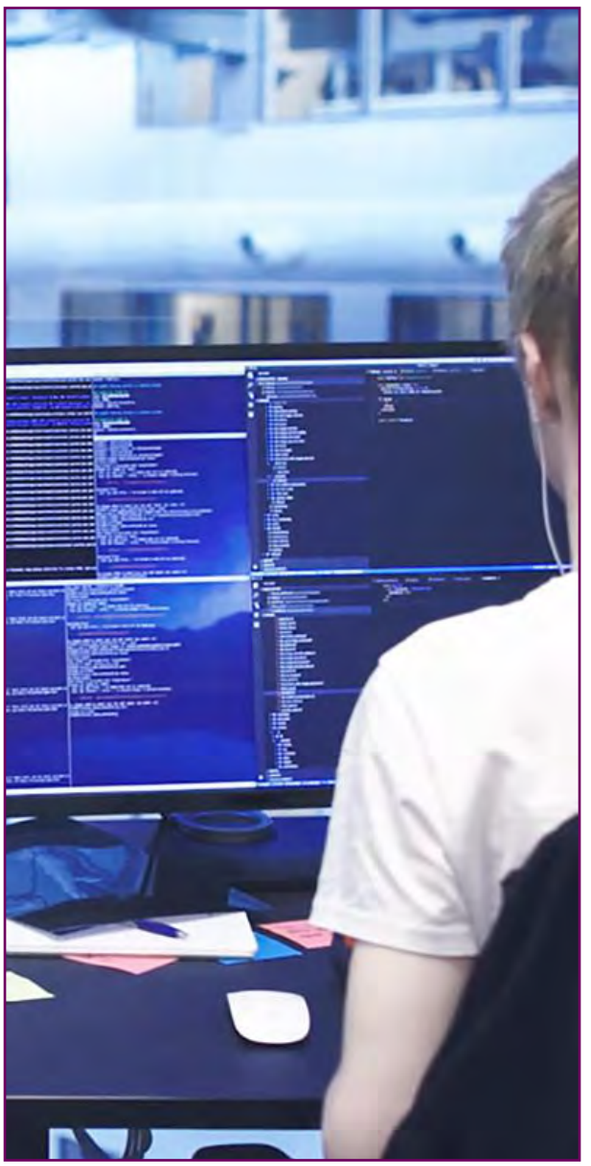
SE-6903 Blockchain Technologies

Bitcoin & Blockchain, Blockchain Structure, Basic Operations, Beyond Bitcoin, Ethereum Blockchain: Smart Contracts, Processing Smart Contracts (Compilation), Deploying Smart Contracts, Best practices in Designing and Evaluating Smart Contracts, Ethereum Structure, Ethereum Operations, Decentralized Applications (Dapps): Blockchain Server, Ethereum APIs, Application Models & Standards: Dapp Models, standard ERC 20 for token Dapps and ERC 721 for non-fungible tokens, Incentive Model, Algorithms & Techniques: Public-Key Cryptography, Hashing, Transaction Integrity, Securing Blockchain Trust Essentials: Decentralized Systems, Consensus Protocol, Decentralized Governance, Robustness, Forks, Blockchain Platforms, Permissioned Blockchains, Hyperledger, Fabric Services, Fabric Model & Functions, Composer, Microsoft Azure. Efforts towards open-source blockchain technologies and its impacts.

SE-6911 Mathematical Foundations of Machine Learning

Introduction to key mathematical concepts for machine learning, Binary classification, Gradient Descent, matrix methods and statistical models and features real-world applications ranging from classification and clustering to denoising and recommender systems. Mathematical topics covered include linear equations, regression, regularization, the singular value decomposition, iterative optimization algorithms, and probabilistic models. Machine learning topics include the LASSO,





support vector machines, kernel methods, clustering, dictionary learning, neural networks, and deep learning.

SE-6912 Introduction to Machine Learning

Introduction, Supervised Learning: Deep Networks, Unsupervised Learning: Clustering, K-Means, Mixture of Gaussians, Expectation Maximization, Principal Component Analysis, Kernel Machines: Convex Optimization, SVM, Gaussian Processes, Latent Space Models: Independent Component Analysis, Graphical Models: HMM, Markov Chain, Monte Carlo Methods, Computational Learning theory: Risk Minimization, VC Dimension, Big data and Scalability, Manifold Learning

SE-6913 Deep Learning

The course will cover a range of topics from basic neural networks, convolutional and recurrent network structures, deep unsupervised and reinforcement learning, and applications to problem domains like speech recognition and computer vision.

SE-6914 Advanced Machine Learning: Theory and Methods

Statistical Decision Theory: Decision Theory Principles and Paradigms, Bayesian Analysis, Minimax Analysis, Statistical Complexity: Empirical Risk Minimization and Decision Theory, Tail Bounds, complexity measures, Sparse Linear Models, Computational Complexity: Optimization and Statistical Complexity, Intro to Computational Complexity, Prediction.

SE-6915 Convex Optimization

Convex sets, functions, and optimization problems. Basics of convex analysis. Least-squares, linear and quadratic programs, semidefinite programming, minimax, extremal volume, and other problems. Optimality conditions, duality theory, theorems of alternative, and applications. Interior- point methods. Applications to various fields.

SE-6916 Probabilistic Graphical Models in Machine Learning

Introduction, Bayesian belief networks (directed graphical models), Markov Random Fields (undirected models), Dual decomposition and NLP applications, Conditional random fields, Exact inference, LP relaxations for MAP inference, Variational inference, Learning (Bayesian networks, unobserved data, EM, Markov networks)

SE-6917 Advanced Topics in Artificial Intelligence

The contents of this course will be developed by the instructor based on emerging trend and active research in the area of Artificial Intelligence.

SE-6931 Sensor Networks

Overview of wireless sensor networks (WSNs), applications of WSNs in various domains, WSNs technologies and systems, MAC protocols design issues, clustering, path finding, routing protocols design issues, transport protocols for WSNs, scalability issues in WSNs, operating systems for WSNs, network management, simulation tools for WSNs protocols design.

SE-6932 Advanced Cloud Computing

Cloud computing architecture: infrastructure, platforms and software, cloud platform components for processing and storage, resource management in cloud, virtual machines, scalability issues in cloud, cloud computing case studies, fog and edge computing, simulation tools for cloud and edge computing.

SE-6933 Advanced Computer Networks

Network design principles, Wireless Networks: Fundamentals, Wireless Networks Technologies: Bluetooth, 802.11, Cellular, Wireless mobility, Wireless TCP, High Performance Networking, Datacenter Fabric, Network Virtualization, Networking Virtual Machines, Datacenter TCP, Switching, Queuing Models, General characteristics of graphs, shortest path problem, efficiency of multicast, hop count to anycast, TCP/IP applications and services, performance analysis, protocol modelling, asymmetric networks and protocol modelling, new TCP/IP standards and flavors.

SE-6934 Advanced Information System Security

Course introduction, basic hardware, software, Internet, information security vulnerability and risk management, access control management, software development security, business continuity and disaster recovery planning, cybercrimes and legal aspects of information security, regulations, information warfare, operation security, physical and environmental security, security architecture and design.

SE-6935 Simulation and Modelling

Basic aspects of modelling and simulation, Simulation process / models and systems, statistical problems related to simulation, discrete and continuous simulation modelling, applications of simulation, introduction to ARENA modelling framework, network modelling, Basic process modules, modelling detailed operations, making decision with simulation, process modelling, advanced modelling techniques, OpQuest for ARENA, costing and animation

SE-6936 Cyber Security

Cyber risk assessment and mitigation strategies, situation analysis, cyber ethics and cyber forensics, penetration testing and ethical hacking, cyberattacks on computer systems, network and cloud infrastructure, generic and protocol-specific cyberattacks, security in IoT, critical infrastructure protection, secure software design, blockchain, cybersecurity of blockchain technology and cryptocurrencies, cyber crimes and law, emerging topics in cyber security.

SE-6951 Advanced Semantic based Software Engineering

Introduction to Semantic Web architecture, knowledge representation techniques, ontology design constraints, Web Ontology Language (OWL), Software Engineering Body of Knowledge (SWEBOK) from semantic web technologies' perspective, analysis of existing implementations in various fields of studies which are related to software design processes.

SE-6952 Advanced Software Engineering Ontologies

The technical architecture of the Semantic Web, Web Ontology Language (OWL) and inferencing, Software Engineering Body of Knowledge (SWEBOK), common ontology design patterns, sharing of ontologies, Existing Shared Ontologies (e.g. FOAF, DC, SKOS etc.), enterprise integration, Ontology alignments, Survey of existing software engineering ontologies and their analysis by integrations/ alignments.

SE-6953 Advanced Human Computer Interaction

Overview of the Usability advancements, aspects which need to be considered in user centred design, effective interaction design, usability standards, usability evaluation techniques and tools, accessibility and its standards, pervasive designs, critical analysis of evaluation usability and accessibility techniques.

SE-6954 Advanced Natural Language Processing

Introduction to natural language processing from a computational perspective. Machine learning in NLP, syntactic, syntactic parsing, information retrieval,

summarization semantics, lexical semantics, NLP processes and their analysis, NLP tools and their critical review.

SE-6955 Advanced Data Visualization

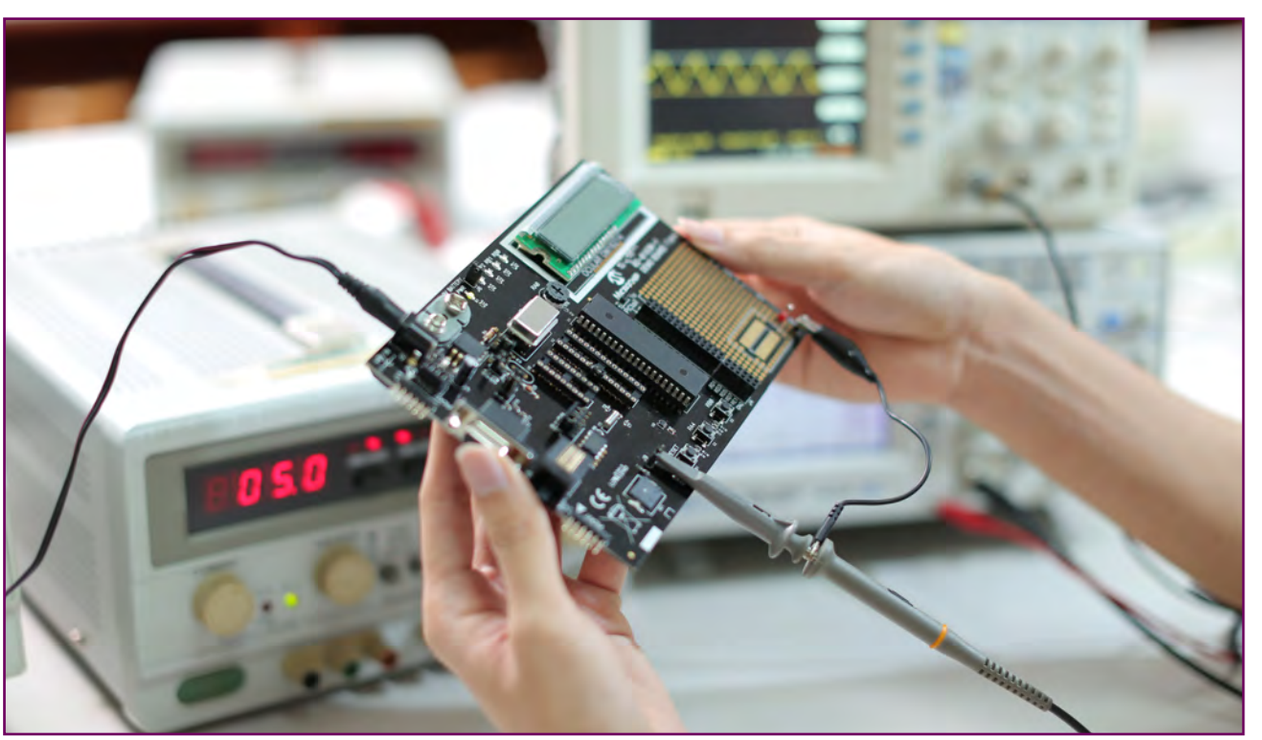
Visualization essentials, visual application, analysis of various types of charts, interactive visualizations, structures, relations, links, state of the art visualization tools, evaluation of the tools in different perspective, automated design.

SE-6956 Advanced Text Analytics

Overview of the language processing, sentiment analysis, opinion mining, topic modelling, pre-processing techniques, reviewing NLP techniques, text semantics, semantic tools, evaluation of tools, analysis of text mining tools and their critical review in terms of accuracy, analysis of frameworks, practices of machine learning methods in text mining processes.

SE-6961 Special Advanced Topics Related to Software Engineering

SE-6999 PhD. Thesis (36 Credit Hours: As per HEC Policy)



UNIVERSITY *of* ENGINEERING & TECHNOLOGY, MARDAN

Department of Telecommunication Engineering

Department of Telecommunication Engineering

INTRODUCTION

The field of Telecommunication Engineering is evolving rapidly with new technological standards introduced with the passage of time. Look back 20 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, anywhere' through mobile networks. The demand for high speed connectivity, live streaming, online video conferencing, e-Learning and distance education, online jobs can be fulfilled after the realization and deployment of next generation of mobile and wireless communication technologies such as 5G and beyond.

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. Department of Telecommunication Engineering is offering BSc. degree since 2002 while the MSc and PhD programs were started in 2012 and 2013, respectively. Telecommunication Engineering encompasses a wide range of topics in line with the latest curriculum of Higher Education Commission (HEC) of Pakistan and the constantly evolving market trends.

DEPARTMENT MISSION

The mission of the telecommunication engineering department is to produce a workforce of outstanding professionals having up-to-date knowledge, technical and interpersonal skills and problem solving abilities to improve the economic well-being and up-lifting of the society.

WHY YOU SHOULD STUDY M.Sc OR 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 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 MSc, and PhD programs. Graduates can expect career opportunities in a wide range of engineering sectors including mobile and telecom industry, telecom regulatory authorities, frequency allocation board, banking, gas exploration and distribution companies, R & D organisation and education and energy sectors, etc. Telecom engineering graduates are particularly well-suited to work as members or leaders of telecom and multi-disciplinary teams.

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.

1. The department received a research grant of Rs. 25.5 million from the ICT R&D Fund Islamabad, for the project called 'Crop Estimation and Geographic Mapping System (CEGMaS). Project CEGMaS focused 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 was a collaborative research project of UET, Peshawar and the Pakistan Space & Upper Atmosphere Research Commission (SUPARCO). The project also helped in offering internships to students from the department.

2. Some projects have matured into commercial applications and products, such as MySmartRemote (http://pk.mysmartremote.com/).

3. An MoU has been signed in 2018 by University of Engineering & Technology, Mardan and North Western Polytechnic University (NWPU), which provides opportunities for collaborative Postgraduate Research and Student placement/exchange program

Research Avenues

- Antenna Design
- Radio Propagation & Modelling
- Radio Mateorology
- 5G and MIMO Technologies
- Acoustics
- Laser Ultrasonics & Non-Destructive Testing
- Metamaterials and Metasurfaces
- Mobile and Satellite Communication
- Signal and Information Processing
- Image and Video Processing
- Microwave and Millimter Wave Engineering
- Plasmonic, Optical and THz Communications
- Cooperative and Cognitive Communication Networks
- Multimedia Forensics & Communication
- Super resolution imaging
- Routing protocols in WSN and Optimization
- Techniques

FACULTY

CHAIRMAN

- Dr. Sadiq Ullah — Ph.D (UK)

ADVISOR POSTGRADUATE STUDIES (APGS)

- Dr. Toufeeq Ahmad — Ph.D (China)

Associate Professor:

- Dr. Sadiq Ullah — Ph.D (UK)

Assistant Professors:

- Dr. Naveed Mufti — Ph.D (UK)
- Dr. Toufeeq Ahmad — Ph.D (China)
- Dr. Syed Haider Abbas — Ph.D (S. Korea)
- Engr. Jalal Khan — M.Sc (UK)
- Engr. Shagufta Naz — MSc (Pak)
- Engr. Abid Jan — MSc (Pak) on Study leave

Lecturers:

- Dr. Sahib Khan — Ph.D (Itlay)
- Engr. Sajjad Ali — MSc (Pak)
- Engr. Humaira Rehman — MSc (Pak)
- Engr. Usman Ali — MSc (Pak)
- Engr. Wasi Ur Rehman Khan — MSc (Pak)
- Engr. Nagina Zareen — MSc (Pak) on Study leave
- Engr. Latifullah Khan — MSc (Pak) on Study leave

Eligibility Criteria for Admission in MSc. Telecommunication Engineering

1. Candidates seeking admission must have a Bachelor's Degree (16 years of education) in a relevant discipline (i.e. BSc. In Telecommunication or BS Telecommunication or BSc in Electrical, Electronics, Avionics, Computer/Computer Systems Engineering or equivalent) from a program accredited by Pakistan Engineering Council (where necessary) and/or programs recognized by the Higher education Commission (HEC) of Pakistan.
2. Candidates seeking admission must score at least 50% marks in GRE General Type test, organized by University Appointed Testing Authority (UATA).
3. 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.

Eligibility Criteria for Admission in PhD. Telecommunication Engineering

1. For admission into the PhD, minimum Master's/M.Phil degrees (18 Years of Education) with CGPA 3.0 out of 4.0 or 3.75 out of 5.0 in Semester System or First Division in Annual System in Telecommunication /Electrical /Electronics/ /Avionics/ Computer/Computer Systems Engineering or equivalent, recognized by the HEC, will be required. The percentage will be valid only if the CGPA is not mentioned in the degree/transcript.

2. 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.

COURSES

A. List of Core Courses

Following is the list of mandatory courses. Students are required to study and pass the following ***five (05)*** courses in the Core Courses Domain:

S.No.	Course Title	Course Title	Credit Hours
1.	TE-5101	Stochastic Processes	3
2.	TE-5102	Advanced Telecom Systems & Networks	3
3.	TE-5103	Advanced Digital Communication	3
4.	TE-5104	Advanced Digital Signal Processing	3
5.	TE-5105	Advanced Antenna Design	3

B. List of Elective Courses

Students are required to study and pass any ***three (03)*** courses from the list of electives in proportion mentioned in each category below:

a. List of Domain Elective Courses

Students are required to study and pass any ***two (02)*** courses from the following Domain Elective Courses:

S.No.	Course Title	Course Title	Credit Hours
1.	TE-5201	QoS in Telecommunication Networks	3
2.	TE-5202	Teletraffic Engineering	3
3.	TE-5203	Cellular Network Planning and Optimization	3
4.	TE-5204	Error Control Coding	3
5.	TE-5205	Advanced Radar Engineering	3
6.	TE-5206	Advanced Satellite Communication	3
7.	TE-5207	Advanced Mobile Communications	3
8.	TE-5208	Advanced Wireless Communication	3
9.	TE-5209	Advanced Network Security	3
10.	TE-5210	Next Generation Networks	3
11.	TE-5211	Sensor Networks	3
12.	TE-5212	Advanced Optical Fiber Communications	3
13.	TE-5213	Advanced Computer Networks	3
14.	TE-5214	Advanced Image Processing	3
15.	TE-5215	Real Time DSP	3
16.	TE-5216	Advanced Microwave Engineering	3
17.	TE-5217	Advanced Engineering Electromagnetics	3
18.	TE-5218	Mobile Ad-hoc Networks	3
19.	TE-5220	Advanced GSM Architecture	3

b. List of General Elective Courses

Students are required to study and pass any ***one (01)*** course from the following General Elective Courses:

S.No.	Course Title	Course Title	Credit Hours
1.	TE-5301	Research Methodology & Technical Writing	3
2.	TE-5302	Simulation and modeling	3
3.	TE-5303	Telecom Regulation and Standards	3

c. Master's Thesis

S.No.	Course Title	Course Title	Credit Hours
1.	TE-5999	Master's Thesis	6

Course Contents:

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 Advanced 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, Grammar-based coding, Yang-Kieffer algorithms, Lossy data compression, Rate distortion function, Scalar quantization, Vector quantization, 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

Outline: 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 Advanced 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-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 Layer Model and ATM Cell Structure; Network Node Interface; ATM Physical Layers; Line Coding; ATM Forum Specifications; 100 Mbps Fibre Based Physical Layer 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; Signaling; 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.

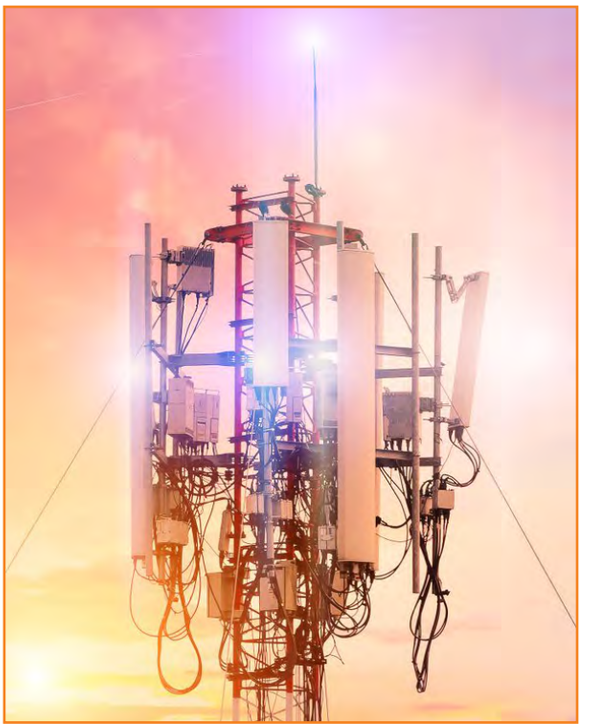
TE-5204 Error Control Coding

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(qm), 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 Advanced 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 Advanced 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 Advanced 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

Mathematical preliminaries, Review of probability theory, Essentials of (convex) optimization theory, Essentials of information theory, Wireless channel models and latest multiple accesstechnologies, 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 spatialmultiplexing, 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 Advanced 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-to-end 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

Introduction and legacy networks, History, Legacy networks, Definition of NGN, Characteristics, Architecture, Enabling technologies, Core network Architecture, Access network (Fixed technologies: copper lines and fibre optics and Wireless technologies: 3GPP based technologies and IEEE based technologies), Drivers and motivation behind NGN (End user requirements, Operator requirements, Competition, Application), Convergence (Drivers for convergence, Fixed mobile convergence, Voice and data convergence),Abstract layering model for NGNs, IP Multimedia Subsystem (IMS),Migration from legacy systems to NGNs and Case studies of present and possible future applications deployed in NGNs.

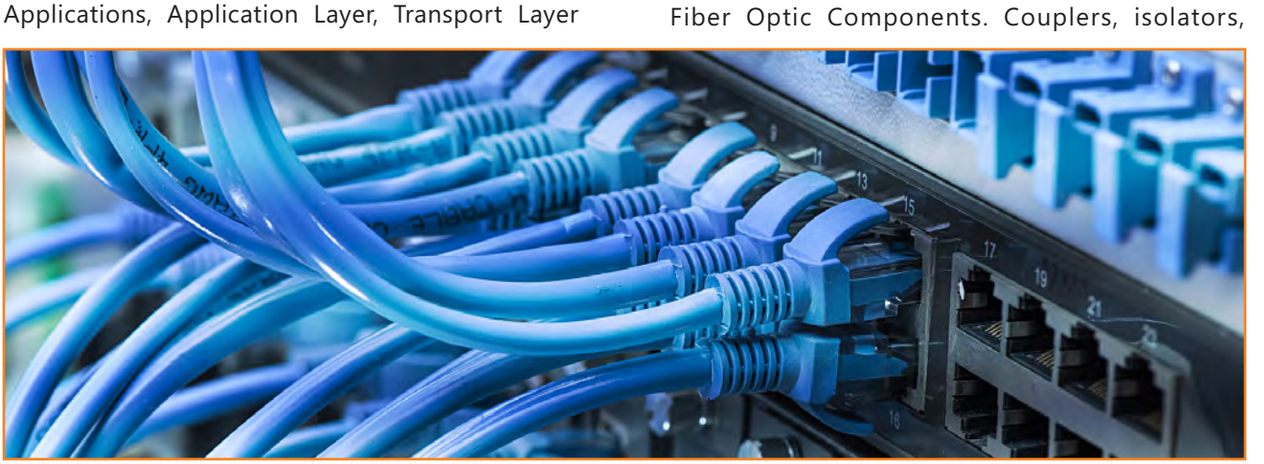
The main objective of this course is to provide students with in-depth understanding of Next Generation Network (NGNs) technologies. The course will cover history, overview, and how NGNs are shaping the current and future ICT landscape. Students will gain both a theoretical understanding and practical 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.

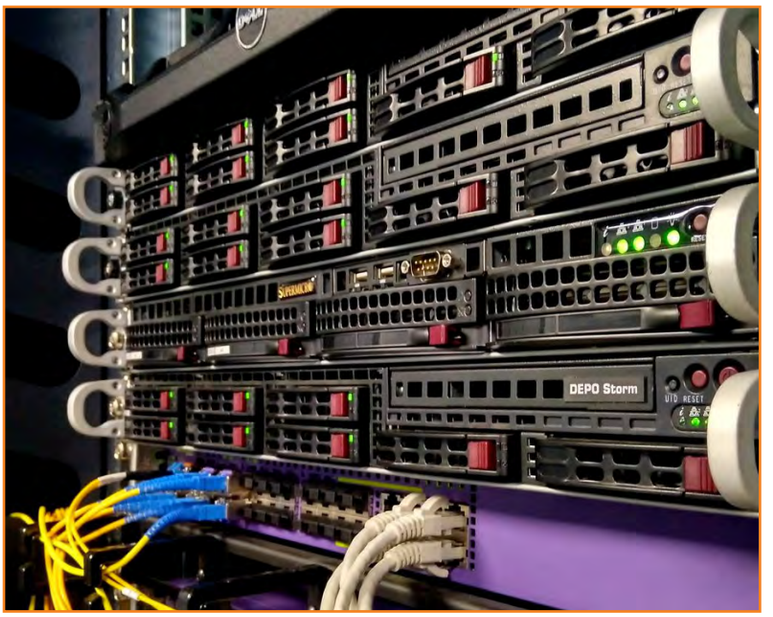
TE-5211 Sensor Networks

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 Advanced 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, non-linearity, 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, quantum 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.

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 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, wave-form 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. Anti alias 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, Non-recursive 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 Advanced Microwave Engineering

Microwave frequencies , Standard Frequency bands, Behaviour of circuits at Conventional and microwave frequencies, Microwave application, Review of Maxwell's equations. Waveguide : 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, H-plane Tee, Magic Tee, Phase-Shifter, attenuators, Directional coupler, Gunn diode, Microwave transistor MASER, Resonator and circulators. Microwave Generators: 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-5219 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.

TE-5301 Research Methodology & Technical Writing

Introduction to the nature of research process, Types of research (experimental/non-experimental), 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.

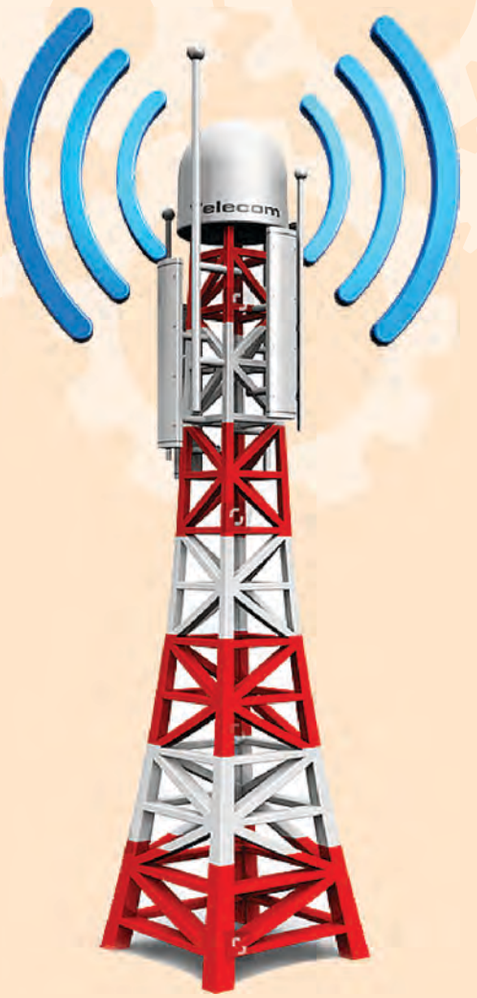
TE-5302 Simulation and Modelling

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.

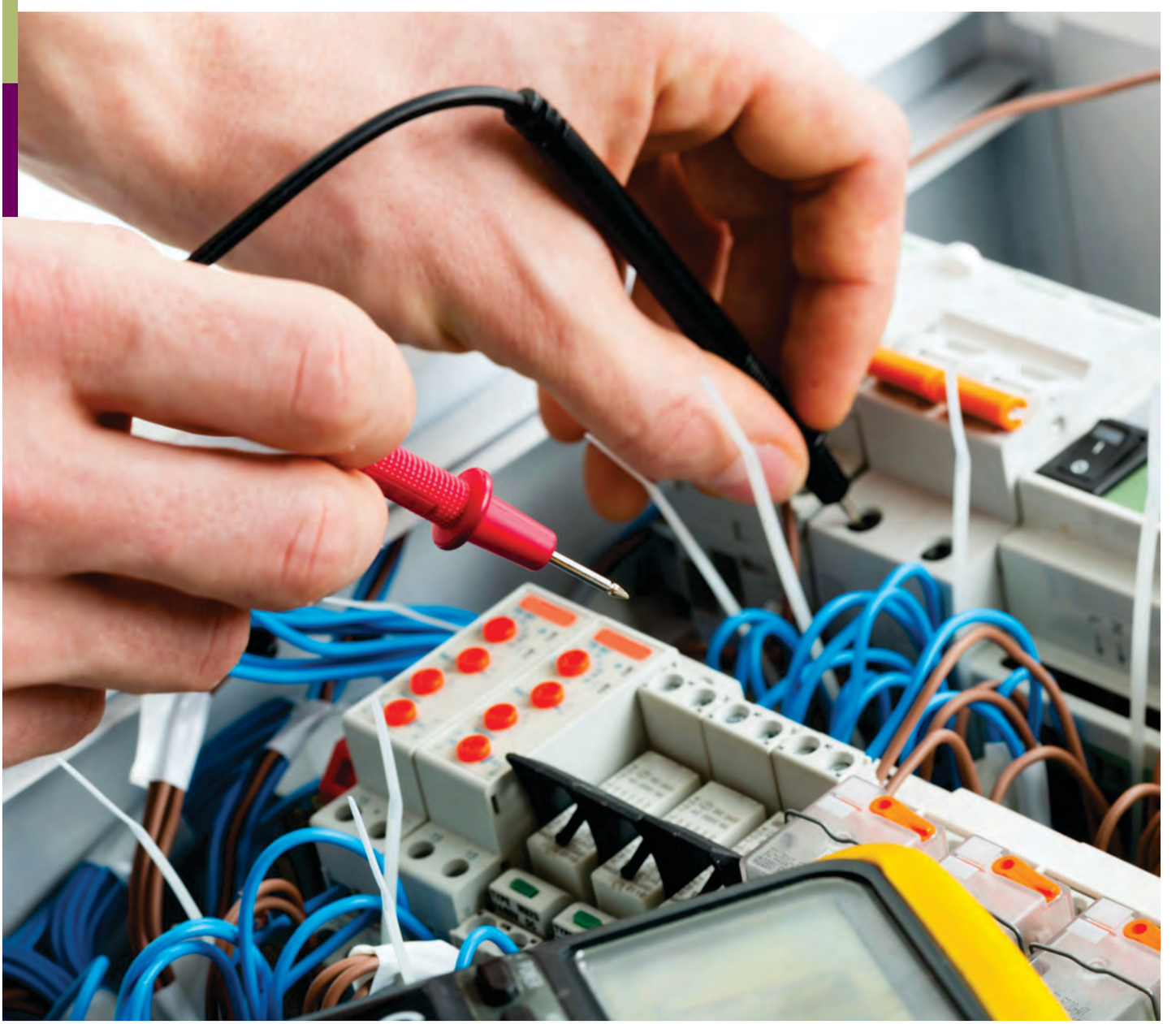
TE-5303 Telecom Regulation and Standards
Introduction to Telecommunications Regulation, Regulating for Effective Competition, Licensing and Authorizing Services, Managing the Spectrum, Network Access and Interconnection, Universal Access and Service, Data privacy protection, Mitigation Measures for Telecommunication installations, Regulatory Challenges in a Brave New World, Regulation of Telecom Sector in Pakistan.

TE-6999 Ph.D Thesis (36 Credit Hours: As per HEC Policy)



UNIVERSITY *of* ENGINEERING & TECHNOLOGY, MARDAN

Department of Electrical Engineering



Department of Electrical Engineering

INTRODUCTION

Area of Electrical Engineering is one of the most dynamic sectors of local and global economy. Development of this sector is driving fundamental changes in all areas of work and life. Electrical Engineering represents an exceptionally wide and interdisciplinary area of engineering science, and there is virtually no human activity in which this discipline does not contribute, either directly or indirectly. The area encompasses the scientific field of electrical engineering with the following branches of science: power engineering, electromechanical engineering, electronics, computer information systems, radio and satellite communications, automation and robotics. The area is recognized as an area of strategic importance for social development. Together with the industrial sector, academia is committed to encouraging development of new educational programs in Electrical Engineering, as prerequisites for development of information society.

WHY YOU SHOULD STUDY MSc. IN ELECTRICAL ENGINEERING?

Continuous and rapid development in the field of Electrical Engineering, driven by new findings and achievements, necessarily requires corresponding educational processes. Well educated and competent researchers and professionals are an essential prerequisite for progress and keeping pace with the technologically advanced countries. Development of a major part of economy, public and private sector in the region striving towards production and distribution of Electric power, management and monitoring of intelligent systems, development and application of electronic and computer systems, and communication and information technology is strongly dependent on researchers and trained personnel's in Electrical Engineering. Therefore, dynamic development of the region will most certainly result in increased need for Electrical Engineering professionals.

Research Avenues

- Power Systems
- Power Generation & Distribution
- Energy Management
- Control Engineering
- Renewable Energy Systems
- Economics of Power Systems
- Instrumentation & Measurement
- Smart Grid Systems
- Embedded Systems
- Radio & Satellite Communication Systems
- Advanced Electronic Circuits
- Artificial intelligence
- Mobile and Satellite Communication
- Digital Signal Processing
- Signal Information Processing
- Digital Image and Video Processing
- Mobile and Computer Networks

FACULTY

CHAIRMAN

- Prof. Dr. Imran Khan — Ph.D (Thailand)

ADVISOR POSTGRADUATE STUDIES

- Dr. Husan Ali, — Ph.D (China)

Assistant Professors:

- Engr. Sheraz Khan — M.Sc (Pak)
- Dr.ZeeshanShaifq — Ph.D (Pak)
- Dr. Husan Ali — Ph.D (China)

Lecturers:

- Dr. Gul Rukh — Ph.D (Pak)
- Engr. Jawad Ali — M.Sc (Pak)
- Engr. Sadia Jabeen Siddiqui — M.Sc (Pak)
- Engr. Haseeb Ahmed Khan — M.Sc (Pak)
- Engr. Khadim Ullah Jan — MSc (Pak) On study leave
- Engr. Mahum Pervez — MSc (Pak)
- Engr. Ghulam Hafeez — MSc (Pak)

Eligibility Criterion for Admission in MSc in Electrical Engineering:

1. Candidates seeking admission must have a Bachelor's Degree (16 years of education) in a relevant discipline. (i.e. B.Sc/BS/BE in Electrical, Electronics, Telecommunication) from a program accredited by Pakistan Engineering Council and program recognized by the Higher Education Commission of Pakistan.

2. Candidates seeking admission must score at least 50% marks in GRE General Type test, organized by University Appointed Testing Authority (UATA).

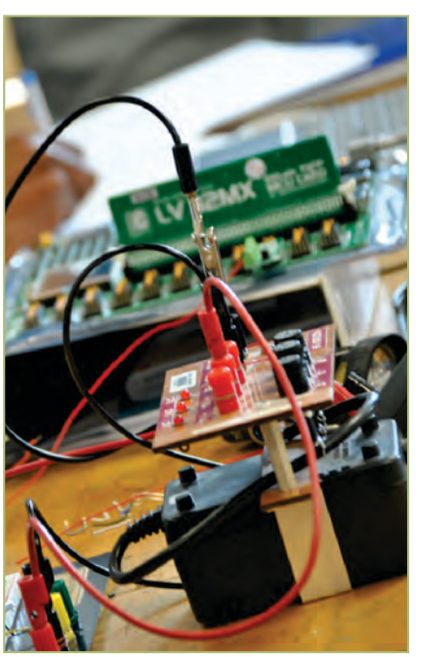
3. Candidates shall have to pass departmental subject and UATA test with at least 50% score. Final merit list shall be made based on the combined results of UATA marks and the departmental test.

4. For award of MSc degree, candidates will either need to complete 30 credit hours of course work or complete 24 credit hours of course work along with a minimum of 6 credit hours for research work/thesis.

Following two streams will be offered for MSc. Electrical Engineering program.

1. Power Systems and Control Engineering

2. Communication and Electronics Engineering



Courses offered for M.Sc Electrical Engineering

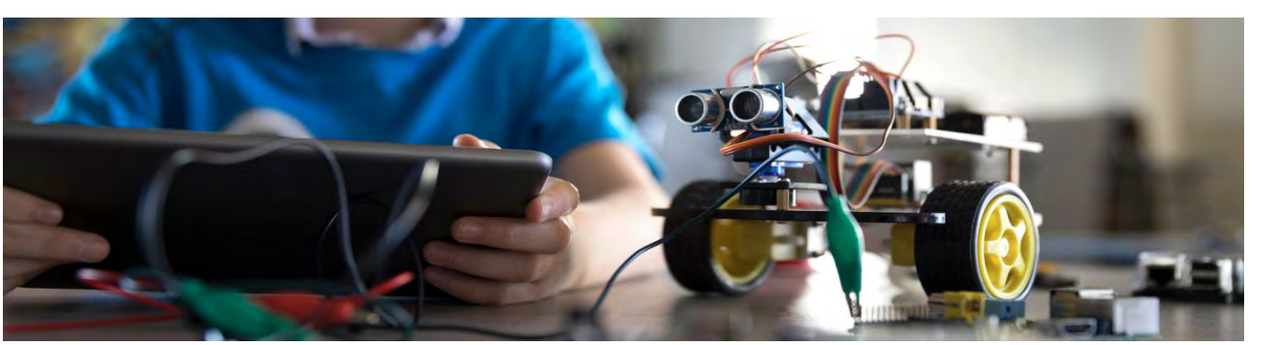
Nomenclature of the subject code is as such:

In code EE-501, "EE" shows that this is course offered at the Department of Electrical Engineering. Number "5" shows that this is postgraduate level course. Number "01" shows this is a core course for Power stream (for communication stream core course starts from "11"). Elective courses in Power stream starts from course code EE-520 while for Communication stream it starts from EE-551. Based on this nomenclature the list of course offering is shown in table below.

Power Systems and Control Engineering	Subject Code	Credit Hours
CORE COURSE		
Power System Modeling and Analysis	EE-501	3
Advanced Power System Transmission	EE-502	3
Advanced Power System Protection	EE-503	3
Advanced Power System Operation and Control	EE-504	3
Renewable Energy Systems	EE-505	3
Power Electronics Devices and Converters	EE-506	3
Modeling and Simulation of Converters	EE-507	3
Power Quality	EE-508	3
Linear System Theory	EE-509	3
Advanced Control Systems	EE-510	3
ELECTIVE COURSE		
Advanced High Voltage Engineering	EE-520	3
Insulation Coordination in Power Systems	EE-521	3
Advanced Power System Stability	EE-522	3
Modeling and Simulation of Electrical Machines	EE-523	3
Special Electrical Machines	EE-524	3
Advanced Electrical Machine Design	EE-525	3
Smart Grid System Operation	EE-526	3
Power System Reliability	EE-527	3
Control of Electric Machine Drives	EE-528	3
Control of Power Electronic Converters	EE-529	3
Power System Circuit Breakers and Sub stations	EE-531	3
Power System Distribution	EE-532	3
Power Generation Economics	EE-533	3
Power System Restructuring	EE-534	3
Condition Monitoring Techniques	EE-535	3
Control of DC Machines and Drives	EE-536	3
Control of AC Machines and Drives	EE-537	3
Switch - Mode Power Supplies	EE-538	3
Energy Management	EE-539	3
Digital Control Systems	EE-540	3
Advanced Power Electronics	EE-541	3

Distributed Generation	EE-542	3
Nonlinear Control System	EE-543	3

Communication and Electronics Engineering	Subject Code	Credit Hours
CORE COURSES		
Stochastic Processes	EE-511	3
Advanced Digital Communication	EE-512	3
Advanced Electronics	EE-513	3
Radiating Systems & Antennas	EE-514	3
Optimization Techniques	EE-515	3
ELECTIVE COURSES		
Advanced DSP	EE-551	3
Microwave Devices	EE-552	3
Microwave Networks & Passive Components	EE-553	3
Secure Communications	EE-554	3
Advanced Digital Communication	EE-555	3
Computational EM	EE-556	3
Microwave IC Design	EE-557	3
Real-time DSP	EE-558	3
Spatial Array Processing	EE-559	3
Filtering & Tracking	EE-560	3
Digital Integrated Circuit Design	EE-561	3
Quantum Mechanics	EE-562	3
Solid State Electronics	EE-563	3
Non - Linear Control Systems	EE-564	3
Photonic Devices	EE-565	3
Linear Control Systems	EE-571	3
Advanced Computer Networks	EE-572	3
Detection & Estimation	EE-573	3
Adaptive Filter Theory	EE-574	3
Information & Coding Theory	EE-575	3
Wireless Communication	EE-576	3
Semiconductor Device Physics	EE-577	3
Semiconductor Processing	EE-578	3
Design and Analysis of Algorithms	EE-579	3



Duration of the Program and Semester-wise course breakdown

- Minimum two
- years program (4 semesters)
- As per HEC guidelines[1], 30 Credit hours (CH) (24 CH of courses and 6 CH of research).
- Research thesis will be a core part of the MSc program as per HEC policies.

Degree Requirements

As per HEC guidelines, in order to obtain MSc. Engg (EE) degree a student must pass a minimum of:

i) Three (3) core courses (9 credit hours)
ii) Five (5) Elective courses (15 credit hours)
iii) Thesis/Dissertation (6 credit hours)

Semester-wise Breakup of Courses:

Semester - 1				
S.No	**Course Title**	**Lecture Hours**	**Lab Hours**	**Credit Hours**
1.	Core I	3	0	3
2.	Core II	3	0	3
3.	Elective I	3	0	3
4.	Elective II (optional)	3	0	3
	Total	9/12	0	9/12

Semester - 2				
S.No	**Course Title**	**Lecture Hours**	**Lab Hours**	**Credit Hours**
1.	Core III	3	0	3
2.	Elective II	3	0	3
3.	Elective III	3	0	3
4.	Elective IV (optional)	3	0	3
	Total	9/12	0	9/12

Semester - 3				
S.No	**Course Title**	**Lecture Hours**	**Lab Hours**	**Credit Hours**
1.	Elective IV	3	0	3
2.	Elective V	3	0	3
3.	Thesis/Dissertation (Part-I)	0	3/6	3/6
4.	Total	6	3	9/12

Semester - 4				
S.No	**Course Title**	**Lecture Hours**	**Lab Hours**	**Credit Hours**
1.	Thesis/Dissertation (Part-II)/Elective IV	0	3	3
	Total	0	3	3

Course Contents:

EE-501 Power System Modeling and Analysis

Modeling techniques for power system analysis, Modeling of power system building blocks, i.e. transformers, motors, transmission lines, Single and three phase systems, Power flow analysis, Bus admittance matrix, Power flow solution, symmetrical and unsymmetrical fault calculations, Economic Dispatch and Unit Commitment, modern power system operation and protection

EE-502 Advanced Power System Transmission

Basic theory of line compensation. FACTS devices, The FACTS optimization problem. Transient and dynamic stability enhancement using FACTS components. Concepts of modern grid.

EE-503 Advanced Power System Protection

Detection of system variables, relays, fuses and circuit breakers, protection of power transformer, motor, generator and lines, voltage and current transformer. Need for power system protection. Types of relays. Protection system terminologies. Current transformer (CT) and Potential Transformer (PT). CT and PT errors. Fuses and their types. Fuse terminologies. Circuit Breakers and related terminologies. Fuse - Fuse coordination. Fuse - Circuit Breaker coordination. Over Current Relays. Three Phase Over current protection. Directional OCR. Differential Protection. Transformer protection. Bus bar protection. Impedance protection. Generator protection. Induction motor protection. Feeder protection.

EE-504 Advanced Power System Operation and Control

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

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.

EE-505 Renewable Energy Systems

Fundamentals of Alternative Energy Sources, Energy Demand and Supply, Environmental and Ecological Effects of Energy Production and Consumption, Energy Conversion, Introduction to Nuclear Energy, Nuclear Power Plants, Fusion Energy, Solar Energy,

Wind Power, Geothermal Energy, Biomass, Power from the Water, Energy Storage, Economics of Energy Projects.

EE-506 Power Electronics Devices and Converters

Introduction to high-power electronics, power switches, and power-electronic converter systems, Principles of electronic power conversion in switched-mode converters. Averaged modeling of switched-mode converters, input filter design. Line-commutated and pulse-width-modulated rectifiers. Analysis and design of PWM (Pulse-Width-Modulated) converters including the selection of components, design of magnetic components, design of feedback loop, performance measurement.

EE-507 Modeling and Simulation of Converters

Voltage-Sourced Converter (VSC) and Pulse-Width Modulation (PWM), Switched and averaged models of the half-bridge VSC, Current-mode and voltage-mode control methods, Three-phase VSC, Sinusoidal PWM (SPWM), and SPWM with third harmonic injection. Space-phasors and vectorial representation of three-wire, three-phase converter systems. αβ-frame and dq-frame transformation. Synchronization and the Phase-Locked Loop (PLL). Real and reactive power control by the three-phase VSC. DC-link voltage regulation in the VSC, and Controlled DC-Voltage Power Port. State-space modeling and analysis of power-electronic converter systems. Analysis of important applications (wind power system, PV system, HVDC systems, etc.)

EE-508 Power Quality

Power Quality Introduction and Concepts, Terms and Definitions, Voltage Sags and Interruptions, Transient Over voltages, Fundamentals of Harmonics, Applied Harmonics, Long-Duration Voltage Variations, Power Quality Benchmarking, Distributed Generation and Power Quality, Wiring and Grounding, Power Quality Monitoring. Power Frequency Disturbance, Electrical Transients, Harmonics, Grounding and Bonding, Power Factor, Electromagnetic Interference, Static Electricity, Measuring and Solving Power Quality Problems.

EE-509 Linear System Theory

Introduction to state-space and system modeling, state-space representation of dynamic systems, simultaneous linear equations, state-transformations and state-transition matrix, eigen-values and eige-vectors, Cayley-Hamilton theorem, analysis and stability of continuous-time 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.

EE-510 Advanced Control Systems

State-Space and Multivariable Control, Digital Control & System Identification, Nonlinear and Adaptive Control Systems, Process Control & Automation, Optimal & Robust Control, Intelligent Control & Robotics, Applied Control

EE-520 Advanced High Voltage Engineering

High voltage transmission systems, Generation of high voltages. Cockroft-Walton cascade rectifier. Transformer cascade. Marx generator for impulse voltages. High voltage dividers. High voltage test technique. Electrical breakdown strength of gaseous, liquid and solid insulation. Dielectric properties of electrical insulation. Complex permittivity and dielectric response functions. Kramers-Kronig relations. Insulation diagnostics. Dielectric spectroscopy. Partial discharges.

EE-521 Insulation Coordination in Power Systems

Introduction; lightning parameters; lightning performance of transmission lines; switching performance of transmission lines; AC performance of transmission lines; modelling breakdown behaviour; insulation co-ordination of substations and distribution networks.

EE-522 Advanced Power System Stability

General background and overview of power system stability issues (angle and voltage stability, transient, midterm and long-term stability), Synchronous machine theory and modelling, AC transmission components, Power system loads, Excitation

systems, Prime movers and energy supply systems, Control of active power and reactive power, Small-signal stability, Transient stability, Voltage stability, Methods for improving stability.

EE-523 Modeling and Simulation of Electrical Machines

Key components - Magnetic principles- Electromagnetic circuits - Use of phasors Fundamentals: Fundamentals: Transformer - Ideal transformer - Three and two inductor model - With all non-idealities Fundamentals: Three phase circuits and Power - Star-Delta connections - Space vectors - Application of space vectors for 3-phase analysis - Relationship of space vectors and phasors - Power in 3-phase systems Fundamentals: Fundamentals: Space vector based Transformer models - Development - 2-phase ITF based generalized model Fundamentals: Electric machines – Generalized model - IRTF concept - Conditions for constant torque - General machine model Fundamentals: Synchronous and Induction machines - Machine configuration Fundamentals: Fundamentals: Lahore University of Management Sciences - Operating principles - Symbolic model - Generalized symbolic model - steady state characteristics, DC machines and Simple Drive System - Symbolic model - Steady State characterisitcs - Single phase uni-polar drive circuit - Single phase bi-polar drive circuit

EE-524 Special Electrical Machines

Stepper Motor: Introduction, Variable Reluctance Stepper Motor, Permanent Magnet Stepper Motor, Hybrid Stepper Motor, Other Types of Stepper Motor, Windings in Stepper Motors, Torque Equation, Characteristics of Stepper Motor, Open – loop Control of Stepper Motor, Closed – loop Control of Stepper Motor, Microprocessor – Based Control of Stepper Motor, Applications of Stepper Motor.

Switched Reluctance Motor (SRM): Construction, Principle of Working, Basics of SRM Analysis, Constraints on Pole Arc and Tooth Arc, Torque Equation and Characteristics, Power Converter Circuits, Control of SRM, Rotor Position Sensors, Current Regulators, Microprocessor – Based Control of SRM, Sensor less Control of SRM.

Permanent Magnet DC Motor and Brushless Permanent Magnet DC Motor: Permanent Magnet DC (PMDC) motor, Brushless Permanent Magnet DC (BLDC) Motors

Permanent Magnet Synchronous Motor (PMSM): Construction, Principle of Operation, EMF Equation, Torque Equation, Phasor Diagram, Circle Diagram, Comparison of Conventional and PMSM, Control of PMSM, Applications.

Synchronous Reluctance Motor: Construction and, Working, Phasor Diagram and Torque Equation, Control, Advantages and Applications

Single Phase Special Electrical Machines: AC series Motor, Repulsion Motor, Hysteresis Motor, Single Phase Reluctance Motor, Universal Motor.

EE-525 Advanced Electrical Machine Design

Advanced topics of electric machines, beginning with dynamic modeling and principles of vector control and evolving into new design and control of electric machines for advanced traction motors and renewable energy generator systems. Advanced electromechanics, Dynamic models, Reference frame transformations, Reduced-order models, Mechanical loads and models, Power electronic drives: dc techniques, ac techniques, models, Digital simulation of electric drive systems

EE-526 Smart Grid Systems Operation

An Overview of the Smart Grid, Renewable Energy Generation, Power Grid, Smart Storage and Electric

Vehicles, Smart Energy Consumption, Communications in the Smart Grid, Security and Safety for Standardized Smart Grid Networks, Interoperability, Integration of Variable Renewable Resources, Future of the Smart Grid.

EE-527 Power System Reliability

Concept of Power System 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.

EE-528 Control of Electrical Machine Drives

Introduction to Rotating Machines: Elementary Concepts, Introduction to AC and DC Machines, MMF of Distributed Winding, Magnetic Fields in Rotating Machinery, Rotating MMF Waves in AC Machines, Generated Voltage, Torque in Non-salient-Pole Machines, Linear Machines, Magnetic Saturation and Leakage Flux.

Synchronous Machines: Introduction to Polyphase Synchronous Machines, Synchronous-Machine Inductances; Equivalent Circuits, Open- and Short-Circuit Characteristics, Steady-State Power-Angle Characteristics, Steady-State Operating Characteristics, Effects of Salient Poles; Introduction to Direct- and Quadrature-Axis Theory, Power-Angle Characteristics of Salient-Pole Machines, Permanent-Magnet AC Motors

Variable-Reluctance Machines and Stepping Motors: Basics of VRM Analysis, Practical VRM Configurations, Current Waveforms for Torque Production, Nonlinear Analysis, Stepping Motors.

Speed and Torque Control: Control of DC Motors, Control of Synchronous Motors, Control of Induction Motors, Control of Variable-Reluctance Motors.

EE-529 Control of Power Electronic Converters

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 (Electro Magnetic Interference), Voltage Mode Control, Current Model Control, Dual Loop Control for power electronic converters (dc-dc, ac-dc, dc-ac).

EE-531 Power System Circuit Breakers and Substations

Detection of system variables, relays, fuses and circuit breakers, protection of power transformer, motor, generator and lines, voltage and current transformer.

EE-532 Power System Distribution

Load modeling of distribution networks, Application of distribution transformers, Design of sub-transmission lines, Voltage drop, Power losses, Distribution system voltage regulation, Distribution system protection, Distribution system reliability.

EE-533 Power Generation Economics

Electricity Boards, Production methods of electrical energy, Formation of electrical energy system, Analysis of electrical consumers, Description and basic calculations from electrical point of view of production installations, Criteria of load satisfaction from electrical production systems, Electrical economy elements, Forming of electrical energy price list.

Function and control of electrical energy systems, energy control centres, hardware and software of energy control, study and forecast of electric load, load curves, least squares method, the production system, thermic energy plants- characteristic curves, hydroelectric energy plants- characteristic curves, economic load dispatch of thermic energy plants, linear programming, Lagrange method, economic energy dispatch considering production-load equivalence, Newton-Raphson method, economic energy dispatch considering production-load equivalence and the functional limits of production plants, economic energy dispatch considering production-load equivalence, the functional limits of production plants and transmission losses, hydro-thermic energy plant co-operation, economic energy dispatch considering the transmission grid limits, generalized Kuhn-Tucker method, electrical energy exchanges, economic electrical energy exchanges, energy exchanges and plant entry.

EE-534 Power System Restructuring

Introduction to restructuring of power industry, Fundamentals of Economics., The Philosophy of Market Models, Transmission Congestion Management., Locational Marginal Prices (LMP) and Financial Transmission Rights (FTR), Ancillary Service Management, Pricing of transmission network usage and loss allocation.

EE-535 Condition Monitoring Techniques

Power quality issues and condition monitoring techniques used in electrical and industrial systems, Power systems and three-phase machines, Power Quality: Electromagnetic interference and interactions in energy systems, types of power quality issues, regulations, standards, prevention techniques, measurements and analysis and real-time tests. Condition Monitoring: Importance, types and features of faults, test methods, sensors and measurement techniques, traditional and advanced diagnostic methods, case studies and real-time tests.

EE-536 Control of DC Machines and Drives

Electric machines, Power converters, Controllers, Load, Modeling of DC Machines, DC motor operation, Model of DC motors, Operating modes in DC motor drives, Electronically - commutated DC motor drives, Phase controlled DC motor drives, Chopper controlled DC motor drives, Control objective, Control structure, Control design, Example of a controller design, Equivalent circuit, Measurement of parameters of induction motors, Steady-states operation of induction motors, Voltage source inverters, Current source inverters, Cycloconverters, Stator-voltage control, Slip-energy recovery speed control, Frequency-controlled induction motor drives, Vector-controlled induction motor drives, Equivalent circuit, Steady-states operation of synchronous motors, Vector control of synchronous motors, Control strategies, Permanent-magnetic brushless DC motor.

EE-537 Control of AC Machines and Drives

Review of Basic Induction Motor Theory, Review of Synchronous Machine Theory, Converters for AC Drives, Adjustable Speed Drive Types, Induction Motor Model, Vector Analysis of Induction Machines, Current Regulation in Power Converters, Simulation of AC Machines and Drives, Complex Modeling for Control Design and Analysis, Field Orientation (FO)–Induction Machines, Field Weakening, Flux Observers and Direct Field Orientation (DFO), Field Orientation Control of Synchronous Machines, Permanent Magnet Synchronous Machine Drives, Direct Torque Control, Sensorless Control, Simulation of Field-Oriented Drives, Motor model, Practical Aspects of Drive Control

EE-537 Switch Mode Power Supplies

Basic Switching Converters, Buck converters, Boost converter, Buck-boost converter, Converter with non-ideal components, Isolated Switching Converters, Forward converter, Flyback converter, Half-bridge converter, Control Scheme, Voltage-mode PWM, Current-mode PWM, Hysteresis Control, Commercial integrated circuit, Resonant Converters, Parallel resonant and serial resonant circuit, Zero-current-switching buck converter, Zero-voltage-switching buck converter, Series-loaded resonant converter, Parallel-loaded resonant converter, Dynamic Analysis, Switch converter models, Negative feedback using classical control techniques, Feedback compensation, Stability, State-space averaged model, Transfer Functions, Converter, Voltage Mode DCM Buck Converter Design, UC3842 based flyback design, Transformer and Inductor Design

EE-539 Energy Management

Energy Management Centres and Their Functions, Architectures, recent Developments, Characteristics of Power Generating Units and Economic Dispatch, Unit Commitment (Spinning Reserve, Thermal, Hydro and Fuel Constraints); Solution techniques of Unit Commitment, Generation Scheduling with Limited Energy. Energy Production Cost – Cost Models, Budgeting and Planning, Practical Considerations, Interchange Evaluation for Regional Operations, Types of Interchanges, Exchange Costing Techniques.

EE-540 Digital Control System

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)

EE-541 Advanced Power Electronics

Averaged switch modeling of switched-mode converters, input filter design, current-programmed control of converters, Cascade connection of converters: Buck cascaded by boost, Boost cascaded by boost.

Converters producing a unipolar output voltage, Converters producing a bipolar output voltage, suitable as dc-ac inverters, Several members of the class of two-inductor converters, Inverse SEPIC, Obtaining isolation in the Cuk converter, Switch stress and switch utilization, Construction of small-signal equivalent circuit model,

Negative feedback: A switching regulator system, Negative feedback, Effect of negative feedback on the network transfer functions, Regulator system small-signal block diagram, Feedback reduces the transfer functions from disturbances to the output Closed-loop output impedance, Construction of the important quantities 1/(1+T) and T/(1+T), construction of T/(1+T), Analytical expressions for approximate reference to output transfer function, Interpretation: how the loop rejects disturbances, Terminology: open-loop vs. closed-loop, A loop gain leading to a stable closed-loop system, Closed-loop response, Design of closed loop system for the buck converter, Measurement of loop gains, Power and harmonics in non-sinusoidal Systems. Power and harmonics in non-sinusoidal systems, and line-commutated and pulse-width-modulated rectifiers.

EE-542 Distributed Generation

Overview of Power Systems and Distributed Generation Systems, Basic models of distribution systems, Introduction to distributed energy sources, Power system control: single- and three-phase systems, per-unit system, Issues related to bidirectional power flow on networks: voltage control, system protection, The basic inverter and interfacing, real and reactive control, Smart grid concepts, HVDC v's HVAC networks: offshore and onshore applications, The energy market: energy pools, bidding, clearing, unit commitment, balancing , capacity and ancillary services, demand-side management.

EE-511 Stochastic Processes

Exploration of noise, uncertainty, and randomness in the context of signals and systems. The course will introduce discrete - and continuous - time random processes as input and/or output signals of various types of systems, with and without memory or feedback. Probabilistic notions will be tightly integrated with techniques from signals and systems, such as linearity, time - invariance, causality, transform methods, and stability. Basic concepts will be illustrated via numerous examples, such as noise in linear and nonlinear circuits, average consensus and PageRank, queuing systems, noise in remote sensing applications, Bayesian filtering, Monte Carlo simulation, risk allocation in financial portfolios, stochastic gradient descent.

EE-512 Advanced Digital Communication

Basic Elements of a Digital Communication System, , Mathematical Models, Analysis of Communication

Signals and Systems , Deterministic Signals and Systems, Bandpass/Lowpass Representations, Signal Space, Random Processes, Bandpass/Lowpass Representations, Series Expansions, Digital Modulation Schemes , Memoryless Modulations, PAM, PSK, QAM, FSK, Multidimensional Modulations, FSK, Biorthogonal, Simplex, Non-linear Modulations with Memory, CPFSK, CPM, Optimum Receivers for AWGN Channels, Optimal demodulation, Correlator, Matched Filter (MF), Optimal detection, MAP, ML, min distance, max correlation, Band-limited channels, Inter-Symbol Interference (ISI), Eye pattern, Signal Design for zero/controlled ISI, Optimum receivers for bandlimited channels with ISI, , Channel Equalization, Linear Equalizers, Decision Feedback Equalizers (DFE), Adaptive Channel Equalization, Adaptive Linear Equalizer, Zero-Forcing (ZF), min Mean Square Error (MMSE), , LMS algorithm, RLS algorithm, Blind equalizer, Adaptive DFE, Carrier , Symbol Synchronization, Carrier Phase estimation, Symbol timing estimation, Multicarrier Systems & OFDM, Multiuser Communications

EE-513 Advanced Electronics

Amplifier Circuits: Transistor as an amplifier, small signal analysis, large-signal analysis, single stage, multistage amplifiers; Classes of Amplifiers: Class A, B, AB, and C amplifiers, push-pull amplifier, complementary symmetry amplifier; Coupled Amplifies: RC-coupled, transformer coupled, direct coupled amplifiers; Frequency response of the amplifiers, audio frequency amplifiers, radio frequency amplifiers, tuned amplifiers; feedback in amplifiers, effect of feedback on frequency response; Practical Amplifier Considerations: input and output impedance matching, amplifier loading; Oscillator Circuits: basic theory, tank circuit, damped and undamped oscillations, phase-shift oscillator, Colpitt oscillator, Hartley oscillator, Wein-bridge oscillator, Clapp oscillator, crystal Oscillator; Analogue Filter Circuits

EE-514 Radiating Systems and Antennas

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.

EE-515 Optimization Techniques

Applications of linear optimization, Geometry of linear optimization, Simplex method, Duality theorem, Sensitivity analysis, Robust optimization, Large scale optimization Network flows, Applications of discrete optimization, Branch and bound and cutting planes, Lagrangean methods, Heuristics and approximation algorithms, Dynamic programming, Applications of nonlinear

optimization, Optimality conditions and gradient methods, Line searches and Newton's method, Conjugate gradient methods, Affine scaling algorithm, Interior point methods, Semidefinite optimization.

EE-551 Advanced Digital Signal Processing

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, Least squares filter design and relation to other filter design techniques Discrete Fourier transform (DFT) and Fast Fourier Transform (FFT) : DFT and its properties, application to linear convolution. Fast Fourier Transform (FFT) algorithms (radix-2, decimation- in-time, decimation in frequency, etc.), short-time Fourier transform, wavelet transform Multi-rate signal processing systems; quadrature mirror filter banks; multilevel filter banks

EE-552 Microwave Devices

RF and Microwave frequencies and technology, Passive microwave components: resistors, capacitors and inductors at RF and microwave frequencies; Transmission lines: coaxial lines, strip line, Slot line, coplanar line, and suspended-substrate strip line; Waveguides and its types (rectangular and circular etc.), Analysis and optimization of transmission lines: Impedance matching, Standing Wave Ratio (SWR), reflection loss, impedance matching on Smith chart, Passive microwave devices and circuits: directional couplers, isolators, circulators, resonant circuits, passive filter design, Active microwave components; Diodes, Transistor at RF frequencies, Small signal RF amplifier design, RF power amplifier, Quantum electron devices, microwave mixers and detectors, principle of RADAR.

EE-552 Microwave Networks & Passive Components

Radio-Frequency (RF) / microwave transmission lines, RF matching networks, microwave resonators, microwave coupler and power dividers, microwave filters, and simulation of RF / microwave circuits. Students will also learn to use the simulation software to model and analyze passive microwave circuits. Matched loads, Movable short circuit, Attenuators, Fixed phase shifters, Junctions and interconnections, Dividers and combiners, Lumped element realizations, Multi-beam forming networks, Non-reciprocal components

EE-554 Secure Communications

Network Security Principles Authentication overview, Biometric authentication, Passwords and password-based authentication, Symmetric- and public-key authentication. Mutual authentication and key exchange, Authenticated key exchange. Mediated authentication and key exchange, PKI and certification authorities System Security: General principles of system security, Authorization and access control, ACLs and capabilities, Access control models, Programming-Language Security, Buffer-overflow attacks, defenses and counterattacks, SQL injection, web security (XSS/CSRF attacks), Web attacks and defenses, Privacy/Anonymity: Database privacy. Network security protocols in practice, SSL, Control-flow integrity, taint tracking, IPsec and IKE, Intrusion detection.

EE-555 Advanced Digital Communication

Information theory: Entropy and source coding techniques, Digital Demodulation & Detection Techniques: Correlator-demodulator, Maximum likelihood detection (MLD) in additive white Gaussian noise (AWGN), Bit Error Rate (BER) performance, Channel Encoder/Decoder: Linear block codes, Cyclic codes, Convolutional codes, Viterbi algorithm, Low Density Parity Check, Tail Biting Convolutional Codes, Information Theory: Source Entropy, Huffman Coding, OFDM (Orthogonal Frequency Division Multiplexing), SC-FDMA (Single Carrier FDMA) and spread spectrum used in broadband communication systems

EE-556 Computational Electromagnetics

Introduction to computational electromagnetics; overview of course, Review of vector analysis and

electromagnetic theory, Finite difference method, Finite difference time domain method, Absorbing boundary conditions, perfectly matched layers, Applications of FDTD to electromagnetic problems, Finite element method, High-order elements, parametric elements, vector elements, Applications of FEM to electromagnetic problems, Integral representations and integral equations, Method of moments, MoM solution of electromagnetic problems, Advanced MoM methods, Hybridization, Summary and discussion on the future of computational electromagnetics

EE-557 Microwave IC Design

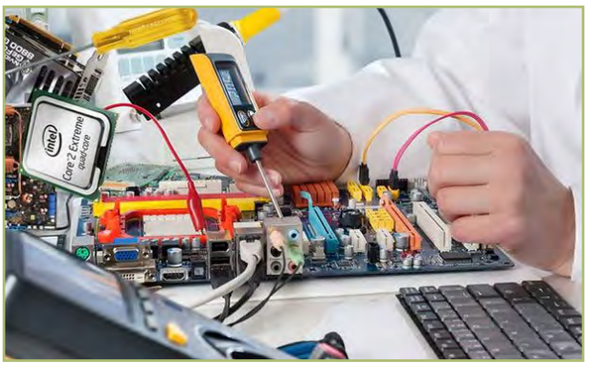
Introduction, Two Port Networks, Transmission Lines, S-parameters, Smith Chart, Impedance Matching, Network Analyzer, MOS and MOS Cross-section, Inductor, Transformer, Resonant tank, Package modeling, amplifier power gain, stability, Constant - gain circles, Conjugate matching, VSWA Circle, LNA overview, Input matching, Output matching, noise figure circles, Substrate effects and Other RF blocks.

EE-558 Real time DSP

Basic Elements of Real-Time DSP Systems, Analog interface, DSP hardware, DSP system design Implementation of digital signal processing using programmable DSP chips. Implementation of real-time data acquisition, real-time FIR/IIR filtering, and real-time FFT algorithms on hardware Platforms such as Texas Instruments floating point DSP platform (TMS320C6713), Fixed-Point Representations and Quantization Effects Overflow and Solutions, Code optimization and Interrupt-driven programming

EE-559 Spatial Array Processing

Introduction, Sensor Arrays, Angle-of-Arrival, and Digital Beam forming, Linear Algebra via MATLAB. Space-Time Signals, Multi-Dimensional Fourier Transform, Plane Wave Decomposition; Resolution, Spatial Aliasing, Beam Pattern Synthesis via FIR Filter Design, Spatial Spectrum Analysis: f-k Domain Velocity Analysis, Phase Velocity, Group Velocity, Dispersion, Fan Filter Design via Multi-Dimensional Filter Design, Beam forming, Time-Domain: Delay-and-Sum, Interpolation, Frequency Domain: Phase Steer, Maximizing Array Gain, DFT Beam forming: ``Beam' Space, Optimal (Least-Squares) Array



Processing, Spatial Spectral Correlation Matrix, MVE: Minimum Variance Estimation
Coherent Interference, Sub-array Averaging, Array Geometry: Sparse Arrays, Modeling Plane Waves in Noise: Prony, IQML, Signal and Noise Sub-Spaces; Eigenvector Techniques, Singular Value Decomposition, Adaptive (Antenna) Arrays, LMS: Least Mean-Square Iteration
Adaptive Nulling, Constrained LMS, Generalized Side lobe Canceller, Blocking Matrix, Partially Adaptive Arrays, Beam-Space Adaptation, RLS: Recursive Least-Squares, Array Imaging
Reconstruction from Projections, Synthetic Aperture (Radar or Sonar), Spotlight & Strip map, Migration. Wideband Beam forming: Space-Time Adaptive Processing

EE-560 Filtering and Tracking

The Kalman Filter: Stochastic state-variable systems; Optimality criteria for the estimation of state variables; The maximum-likelihood solution for independent Gaussian noise processes; The innovations sequence; The least-squares Kalman filter; Systems with correlated noise processes; Stochastic systems with time-invariant coefficients; The square-root algorithm; The extended Kalman filter, Adaptive system identification. Tracking theory: alpha-beta trackers, Kalman-filter tracking; Probability data association tracking hidden Markov models and the Viterbi algorithm.

EE-561 Digital IC Design

CMOS Logic, Switch Models & Simple RC Models, IC Fabrication, Layout & Design Rules, Device Physics, MOS Models, Device Scaling & Short-channel effects Inverters (CMOS, Pseudo NMOS), Static CMOS & Pseudo NMOS Logic Gates, Pass Transistor Logic, Dynamic Logic & Other CMOS Logic Families, Timing Clock Routing Buffers, Pad-Frames, Static/Dynamic Flip-Flops, Registers, Semiconductor

Memory, Counters & Arithmetic Elements, CMOS Logic Families/Dynamic Logic, Design Flow Testing, Basic Economics for Full and Semi Custom Approaches

EE-562 Quantum Mechanics

photoelectric effect, Compton scattering, photons, Franck-Hertz experiment, the Bohr atom, electron diffraction, de Broglie waves, and the wave-particle duality of matter and light. Introduction to wave mechanics: Schrödinger's equation, wave functions, wave packets, probability amplitudes, stationary states, the Heisenberg uncertainty principle, and zero-point energies. Solutions to Schrödinger's equation in one dimension: transmission and reflection at a barrier, barrier penetration, potential wells, the simple harmonic oscillator. Schrödinger's equation in three dimensions: central potentials and introduction to hydrogenic systems.

EE-563 Solid State Electronics

The course presents fundamentals of the solid-state electronics. The topics include electronic band structure of semiconductors, basic concepts such as Fermi level, band gap, mobility, carrier recombination. The main emphasis will be on principles of the solid-state device operation. The devices that will be considered in detail include field-effect transistors, bipolar and metal-oxide-semiconductor transistors. The course will also cover device fabrication issues, particularly overview of the molecular beam epitaxy, manufacturing of contacts and p-n junctions.

EE-564 Non-Linear Control Systems

Introduction to nonlinear and time-varying systems. Mathematical background, including vector spaces and norms. Lp norms for signals, induced norms for systems, and the Lebesgue Lp spaces. Existence and uniqueness of solutions to nonlinear differential equations. Techniques for the stability analysis of nonlinear and time-varying systems. Internal stability of feedback systems. Phase plane portraits. Lyapunov stability theorems. Popov and circle. criteria for nonlinear feedback systems. Passivity and small gain for nonlinear operators. Overview of design for nonlinear systems. Jacobian linearization and gain scheduling. Introduction to feedback linearization and extensions of optimal control techniques. Direct design methods.

EE-565 Photonic Devices

Theory, design, fabrication and applications of photonic materials and devices. Survey of optical materials design for semiconductors, dielectrics and polymers, the course examines ray optics, electromagnetic optics and guided wave optics; physics of light-matter interactions; and device design principles of LEDs, lasers, photodetectors, modulators, fiber and waveguide interconnects, optical filters, and photonic crystals. Device processing topics include crystal growth, substrate engineering, thin film deposition, etching and process integration for dielectric, silicon and compound semiconductor materials. Mircophotonic integrated circuits and applications in telecom/datacom systems.

EE-571 Linear Control Systems

Model Based Controller Design, Control structures and performance measures, Design of controller for SISO system, Controller design for TITO processes, Limitations of PID controllers, Effects of measurement noise and load. Frequency Domain Based Identification, Identification of dynamic models of plants, Relay control system for identification, Off-line identification of process dynamics, On-line identification of plant dynamics. Time Domain Based Identification, State space based identification, State space analysis of systems, State space based identification of systems-1, State space based identification of systems-2, dentification of simple systems, Identification of FOPDT model, Identification of second order plus dead time model, Improved identification using Fourier series and wavelet transform, DF based analytical expressions for on-line identification, Reviews of DF based identification. Design of Controllers, Advanced Smith predictor controller, Design of controllers for the advanced Smith predictor, Model-free controller design, Model based PID controller design, Model based PI-PD controller design, Tuning of reconfigurable PID controllers.

EE-572 Advanced Computer Networks

Resource management, Congestion control techniques in TCP, Intra-domain and Inter-domain routing protocols, IPv6, Software-defined networks, Content-aware networks, Wireless and data-centric networks, Network performance modeling and

estimation, Queuing analysis, Markov chains, Integrated and Differentiated Services, Protocol support for QoS (RSVP, MPLS), Selected issues in unicast routing, Multicast routing, Internet of Things, Switch/router architectures, Basic interconnection networks, Wavelength Division Multiplexing (WDM), Optical networks beyond point-to-point

EE-573 Detection and Estimation

Statistical Model and Inference, Statistics and Sufficient Statistics, The Bayesian, Minimax and Neymann-Pearson Detectors, Structures of Discrete-time Detectors, Sequential detection. Distributed detection and fusion. Performance Bounds: Chernoff, Bhattacharyya, and Random Coding Bounds. MMSE and MAP Estimators. Kalman Filter. Theory of Point Estimation. Minimum Variance Unbiased Estimation. Maximum Likelihood Estimation and Least Squares. Cramer-Rao lower bound and other performance bounds. Cramer's Theorem. Gartner-Ellis's Theorem. Sarnov's Theorem. Application in Detection and Parameter Estimations.

EE-574 Adaptive Filters Theory

Introduction to Learning, Review and background, Probability and Random Processes, Linear Algebra. The Linear Model and Hoeffdings Inequality. Error and Noise. Training versus Testing. The Theory of Generalization. The VC Dimension and the Bias - Variance Tradeoff. Optimum Filtering, The normal equations and the Wiener filter, Linear prediction. The discrete Kalman filter. Particle Filters. Gradient - based adaptive filters, Steepest descent, The LMS algorithm. Recursive Least Squares (RLS). Adaptive IIR filters. Neural networks, The perceptron, multilayer perceptron, Back propagation algorithm. Overfitting, Regularization, and Validatio. Support Vector Machines and Kernel Methods. Radial Basis Functions

EE-575 Information & Coding Theory

Convexity, monotonicity and continuity properties. Extremization, saddle point, capacity as information radius. Variational characterizations: Donsker-Varadhan and Gelfand-Yaglom- Perez. Entropy rates and theorem of Szego. Variable length and fixed length (almost lossless). Linear compression. Slepian-Wolf problem. Ergodic sources: Shannon-McMillan and Birkhoff-Khintchine theorems. Basics of universal data compression. Optimality of Lempel-Ziv. Bounds for finite number of samples. Asymptotics: Stein and Chernoff exponents. Large deviations: Sanov, I-projection, tilting. chievability and converse bounds. Asymptotics: Capacity, strong converse, error-exponents, channel dispersion. Gaussian channels (parallel, with intersymbol interference, minimal energy-per-bit, continuous time). Coding with feedback: Zero and non-zero error capacities, Schalkwijk-Kailath and variable length codes. calar quantization and Panter-Dite approximation. Vector quantization and rate-distortion theorem. Separation principle. Capacity of a multiple-access channel. Gelfand-Pinsker problem. Interference channels.

EE-576 Wireless Communication

Wireless channel models, Cognitive Radio Propagation, shadowing, fading Radio trunking, Vehicular Ad Hoc Networks, Wireless Sensor Networks, Multiple access schemes: FDMA, TDMA, CDMA, Cellular communications, Diversity, Equalization, Channel coding, Wireless systems and standards (1G/2G/3G systems), Speech coding, OFDM, Multiuser detection, space time coding, smart antenna, software radio, Traffic Engineering

EE-577 Semiconductor Device Physics

The course will focus on the physics of semiconductor devices and the principals of their operation. The initial parts of the courses will be used to establish a solid understanding of aspects of electrical conduction in semiconductors. The major part of the course will be focused on different types of metal oxide semiconductor field effect transistors (MOSFETS) and MOSFET devices which are the dominant type of devices in the semiconductor device market. The use of transistor devices and their design and optimization for integrated circuit applications will be presented in detail. Nanoscale transistor dimensions and the effect of such dimensions on transistor behavior will be presented. The physical limits to the scaling of CMOS devices will be discussed in detail.

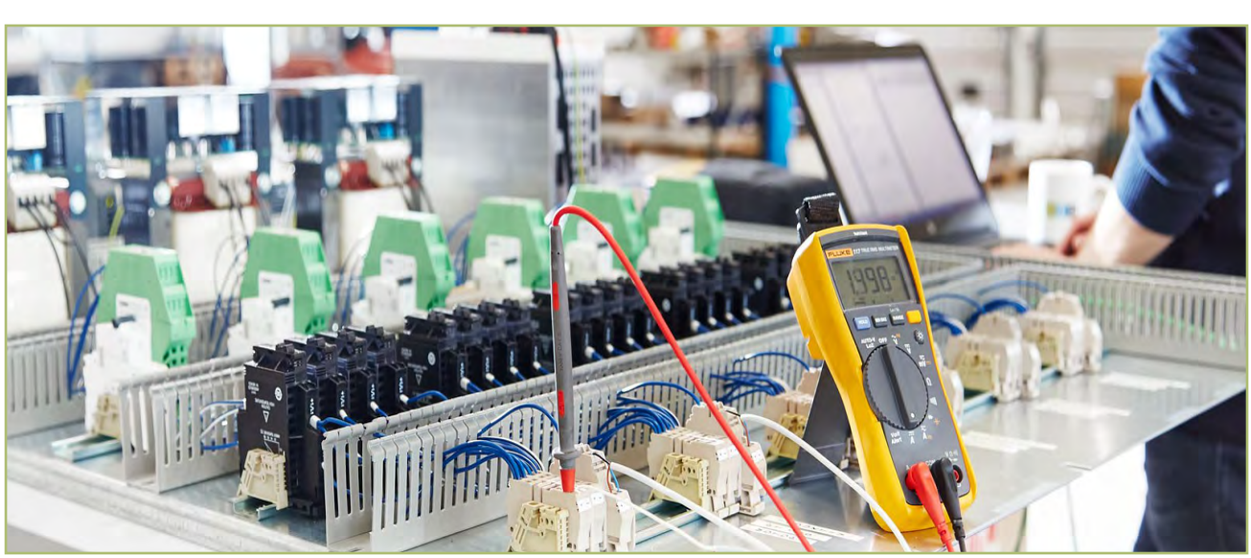
EE-578 Semiconductor Processing

The basics of the technology of semiconductor materials such as silicon, III-V, II-VI and organic materials. Introduction to silicon technologies, key processing steps and equipment, crystal structures and defects in wafer, wafer preparation, Czochralski

crystal growth, defect treatment, doping and oxidation of materials, diffusion equations and profiles; oxidation enhanced diffusion. Thermal oxidation kinetics, oxidation equipment; basic aspects of CVD, gas phase mass transfer/surface reaction, rate determining step, sticking coefficient, step coverage of thin films and advantages/ disadvantages, types of reactions in CVD: APCVD, LPCVD and PECVD; physical vapor deposition technique, principle of sputtering process, plasma physics of sputtering, Structure and properties of sputter deposited films, sputtering techniques: RF sputtering, DC magnetrons, bias sputtering, reactive sputtering and ion metal plasma sputtering, Ohmic contact formations; Photolithography, photoresist material parameters: resolution, sensitivity and viscosity. Optical photoresist material types, photoresist processing, optics of microlithography, methods of transferring patterns, pattern registration. Ink-Jet printing method, wet etching technology, etchants, lift-off technology for patterning electrode, basic physics and chemistry of plasma etching and reactive etching, processing issues related to dry etching.

EE-579 Design and Analysis of Algorithms

Asymptotic Notation and Performance of Algorithms, Searching and Sorting, Divide and Conquer Algorithms, Graphs, Dynamic Programing, Greedy Algorithms, Randomized, Algorithms, P and NP and NP-Hard Problems and Reductions, Unsolvable Problems, Approximation Algorithms



UNIVERSITY *of* ENGINEERING & TECHNOLOGY, MARDAN

University Rules & Regulations

Master Degree Programme

GENERAL

The Master's degree programme at the University of Engineering and Technology Mardan shall extend over a period of at least four semesters. A total of 30 credit hours (including 24 credit hours of courses and 6 credit hours of research) are required to complete the Master's Degree Programme.

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 (16 years of education) in a relevant discipline from a program accredited by Pakistan Engineering Council (where necessary) and/or programs recognized by the Higher education Commission (HEC) of Pakistan.

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 submitted to the Director Admissions, within due date advertised in newspapers, after which no application shall be entertained.

e) Seats for Pakistani students are given in Table-1. 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 test and UATA test with at least 50% marks in each. Final merit shall be determined 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 year while subject test shall be conducted each time admission is offered.

If the university, remain closed due to the COVID-19 pandemic till 1st August-2020 and ETEA does not conduct the entry test, in that case the following criteria will be used for determining the merit for admission in the MSc. Programs of UET Mardan:

Criterion	Weightage
CGPA or Marks Obtained in B.Sc.	40%
Marks obtained in Departmental Entry Test*	60%

***Note:** The Departmental Entry Test will be conducted in university premises for all the departments on alternate days by keeping the strict COVID-19 guidelines in practice. Passing marks for the subject test will be as per HEC guidelines.

Table-1: Seat Allocation for Pakistani Students for Fall-2020 and Spring-2021 Semester

Department	Seat Reserved for Open Merit	Seat Reserves for Rationalized Fees Basis	Total
Computer Software Engineering	35	10	45
Telecommunication Engineering	35	10	45
Electrical Engineering	35	10	45
Total	105	30	135

Note: Exact number of open merit seats as per semester quota will be offered in each semester. Furthermore, if an open merit seat remains vacant in Fall semester then it shall be added to the quota of open merit seats to be offered in Spring semester.

h) On the recommendations of the Admission Committee, the vice-chancellor shall approve the names of candidates selected for admission.

i) A candidate's admission shall be confirmed after he/she has deposited the prescribed fees with the University within the period specified for this purpose.

j) No student shall be admitted after two weeks of the start of classes.

k) The Director Postgraduate Studies shall forward the particulars of each student admitted for the first time, within 15 days of the completion of admission to the Controller of Examinations. The Controller shall assign a registration number to each student, if not already registered with UET Mardan.

l) Admission of any student is liable to be cancelled if his/her academic progress or conduct at any stage is found unsatisfactory.

m) Students registered for Master's programme shall not be allowed to participate in various students' organizations.

n) The facility of hostel accommodation for Master's students shall be provided on need basis, subject to availability.

o) If any of the particulars given by the candidate in his/her application are found incorrect or facts are suppressed, he/she shall be denied admission. If any incorrect or false statement or suppression of facts is detected after a candidate has been granted admission, his/her admission shall be cancelled and he/she shall be expelled from the University at any time during the course of his/her studies.

p) A candidate who is already a bonafide, full time student 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 UET Mardan shall be cancelled.

q) At the time of admission, selected candidates shall submit an undertaking to abide by the Rules and Regulations prevailing in the University. This shall be according to the prescribed proforma on non-judicial Stamp Paper worth Rs.50/-, and duly attested by an Oath Commissioner.

r) In the event of a tie of aggregate marks (UATA+Departmental Subject Test) between two or more candidates seeking admission in the Master's Programme, the subject test marks will be considered. In case these are equal then older candidate shall be considered.

1.1.1 Admission of Foreign Students

a) The applications of foreign students must be routed through the Director, Academics, Higher Education Commission, Sector H-9, Islamabad (www.hec.gov.pk). All applicants of this category should submit, along with their application forms:

   (i) A certificate showing proficiency in English language, e.g. TOEFL or IELTS with a minimum score of 50%.

   (ii) A financial statement confirming the availability of funds for completing the Master's Degree programme.

b) Foreign students seeking residential accommodation at the University Campus may apply to the Provost, University Hostels.

c) Foreign students are exempted from entrance test for admission.

d) Six (06) floating seats are reserved for foreign students in the Postgraduate Programme of UET Mardan.

1.2 Academic Advisor

Any faculty member with at least Master's degree in the relevant field shall be appointed as the Academic Advisor for the postgraduate program of a Department.

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 ASARB (Advance Studies and Research Board) Secretariat. The duties of the Postgraduate advisor will include:-

a) Providing guidance to students on rules and regulations of the Master's Degree Programme.

b) Providing guidance to students on selection of research projects.

c) Organizing field trips of Master's students.

d) Promoting links with industries and other outside organizations.

e) Promoting faculty research.

f) Organizing extension lectures, seminars, workshops and training courses in the departments.

g) Supervising reference library in the department

h) Coordinating with the Academic Advisor of Master's students on various issues, such as registration, selection of courses and general programme of study

1.4 University Fees

University fees for postgraduate students enrolled on open merit seats are shown in Table 2. 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:

%age of Tuition Fee	Timeline for Semester System
Full (100%) Fee Refund	Up to 7 day of commencement of classes
Half (50%) Fee refund	From 8 -15 day of commencement of classes
No Fee (0%) refund	From 16 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.

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

1.5 Registration

a) At the beginning of each semester, students shall register for courses in consultation with the departmental Academic Advisors.

b) List of courses offered in a Department shall be finalized by Postgraduate Advisor of the relevant field of specialization, in consultation with Academic Advisors, and this shall be displayed on the postgraduate notice board, one week before registration, to facilitate students in choosing courses.

c) Minimum number of students to register for a course shall be five for all the Departments, otherwise, the course shall be dropped for that semester. In case a course is dropped by the Department, the fees shall be refunded to the students or adjusted in the coming semesters. However, the departments can offer course(s) to a class having less than five students in exceptional cases with the approval of Dean. A department can also offer course(s) to students relevant to M.Sc Thesis in the area of research.

d) To ensure quality of teaching the maximum number of students in each section of Postgraduate course should not be more than 20. If the number of registered students in any subject exceeds 20, then they shall be accommodated in more than one section.

e) A student who wants to freeze a semester shall have to register in a "Zero Semester" subject to the following conditions:

i. He/She will pay registration fee of Rs. 3000 for the "Zero Semester"

ii. He/She will apply within 15 days of start of the classes

iii. He/She will be allowed to clear his/her subjects prior to "Zero Semester"

iv. He/She can resume his/her studies in a given semester subject to the approval of the Chairman.

1.6 Work Study Load

A student shall not be allowed to take more than three courses per semester.

1.7 Addition of Courses/Withdrawal from Courses

a) A student may be allowed to add/drop courses within two weeks of the beginning of classes.

b) A student may be allowed to withdraw from courses within nine 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 Mardan, fees shall be refunded to student(s).

d) In case a student fails to apply for withdrawal from a course and remains absent, F Grade will be awarded.

1.8 Class Work and Attendance

A student shall attend the classes regularly, submit assignments in time, and appear for tests and examinations when announced by the teacher. Candidates with less than 75% attendance in a course shall not be allowed to appear in the final examination of the course.

1.9 Examination

1.9.1 Course Work

a) For all taught courses of MSc Programme, a final term examination having 50% weightage must be carried out. The remaining 50% marks can be distributed over quizzes, home assignments, mid term examination, mini projects etc, or any other appropriate way, as it suits the requirement of the course. However, such distribution should be clearly spelt out in writing before the commencement of the course and be submitted to the Postgraduate Advisor of the respective departments.

1.9.2 Research work

a) The M.Sc research proposal (submitted by a student at the end of second semester of his/her Postgraduate Studies) shall be initially vetted by Project Research Evaluation Committee (PREC), formally constituted for each specialization in each discipline before recommending it to the ASARB 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 Director ASARB. The Chairman of the concerned department will act as a convener of the PREC. The PREC will be reconstituted after a period of one year. The Chairman of the concerned department may recommend a PhD faculty member, expert in the relevant area, to act as member (co-opted) for the PREC.

b) All MSc 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 MSc degree, at least one paper should be published from the MSc research thesis in a refereed national/ international conference or journal.

d) The maximum number of postgraduate students under a Research Supervisor shall be twelve (12) which will include maximum of five (05) PhD students.

1.9.1.1 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 in course work and satisfactory grade (S) in research. Grade Points are assigned as shown in Table 3.

Table-3: Grade Points

A	4.00
A-	3.67
B+	3.33
B	3.00
B-	2.67
C+	2.33
C	2.00
C-	1.67
D+	1.33
D	1.00
F	0.00
I	Incomplete
W	Withdrawn
S	Satisfactory (for thesis only
U	Unsatisfactory (for thesis only

b) A student who has been awarded "F" grade in a course may be allowed to improve the grade by repeating the course within the prescribed time limit. 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 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 Semester Grade Point Average (SGPA) will be calculated as follows:

Quality Points of each course = Grade Points of grade awarded x Course credit hours.

SGPA = Sum of Quality Points of all courses / Total credit hours

e) Improvement of grade "C" and below:

Students taking grade "C" or a lower grade than "C" will get a maximum of two chances to improve the grade by repeating the course. Tuition fees will be charged for repeating the course. The student will get no additional credit for repeating the course. After repeating the course and fulfilling all its requirements including exams, the instructor concerned will award the student a fresh grade.

1.11 Medium of Instruction

The medium of instruction in all Postgraduate Courses shall be English. Foreign students will be required to satisfy the concerned department about their proficiency in English before registration.

1.12 Duration of Courses

a) There will be two semesters in an academic year. Each semester will be of eighteen weeks duration, including classes and conduct of examinations.

b) The Fall semester, will start in the first week of September and the Spring semester will begin in the first week of February.

1.13 Degree Requirements

a) The course and research work should be completed within 1.5 to 4.0 years as per HEC guidelines.

b) Total of 30 credit hours (including 6 credit hours of research and 24 credit hours of course work) are required to complete the Master's Degree Programme.

c) 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.

d) On the completion of course and research work, the student shall apply for defense of thesis on a prescribed proforma available from the Directorate of Postgraduate Studies/ Departmental Postgraduate Advisor and University website (www.uetmardan.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 defense.

e) After successful defense 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 defense 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 Library of the University and the Directorate of Postgraduate studies.

f) The student must complete all the requirements of the MSc Degree within forty eight months (08 semesters) of the first registration for the programme.

g) The degree of Master of Science (MSc) shall be awarded to a student who has satisfactorily completed the courses of study and research and has passed the required examinations.

h) The student shall apply for the award of MSc degree on a prescribed proforma available from Directorate of Postgraduate studies/ Departmental Postgraduate Advisor and University website (www.uetmardan.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 defense examination.

I) 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 ASARB on the recommendation of the PREC 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 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 Assistantship 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 lab courses to the under-graduates students only, with a financial assistantship of Rs. 5000/- per month along with tuition free ship.

b) Research Assistantship: Assignment on project work. Rs.5000/- per month with tuition free ship.

c) Other fellowship/financial assistance shall be announced when available.

1.19 Admission on Rationalized Fees Basis

a) Eligibility criteria for "Rationalized Fees Based" applicants are the same as for open merit applicants.

b) Fees for Rationalized Fees Based Students are shown in Table 4. In case of Admission Cancellation the refund policy is as under:

%age of Tuition Fee	Timeline for Semester System
Full (100%) Fee Refund	Up to 7 day of commencement of classes
Half (50%) Fee refund	From 8 -15 day of commencement of classes
No Fee (0%) refund	From 16 day of commencement of classes

Late fee of Rs.200/- per day (maximum up to Rs.1,800/-) will be charged from the students who failed to deposit the University dues/funds within due date for any reason.

c) A private student who wishes to take a course without taking admission in the Master's Programme, should formally submit an application to the Chairman of the Department concerned. After permission of the Chairman concerned, he/she will be allowed to enroll subject to the availability of space after payment of Rs. 20,000/- per course. Further he/she will not be allowed to take more than two courses without taking admission in Master's Programme. He/she will be awarded a Certificate by the Chairman of the Department concerned for attending the course(s) without claiming any credit.

1.19 Special Provisions

1. In all cases where regulations are silent, the decisions of the vice-chancellor shall be final.

2. All other regulations and instructions relating to Master's Engineering courses issued here-to-fore stand repealed.

3. 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.

4. Interpretation of these rules and regulations by the authorized officers of the University shall be final.

Table-4: Fees and other Charges for Rationalized Fees Students

S. No	Item	Pakistani Students (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

1.19 Cancellation of Admission

1. A bona-fide student of the University may apply in person, or through parents/ guardians for cancellation of admission on a non-judicial stamp paper worth Rs.50/- duly attested by an Oath Commissioner. The Chairman of the concerned department shall cancel the admission of the student and notify the same.

2. In case, the admission of 1st semester student is cancelled due to any reason, the rules regarding University fee/dues chargeable/ refundable mentioned in the university fee section of the postgraduate prospectus 2020-21 will be applicable. Whereas in all other cases, all outstanding dues/fees etc. till date must be paid.

3. A bona-fide student of the University who joins any other Department/Intuition or Academy for the purpose of study shall be liable for immediate cancellation of his/her admission. In such case only the Library & Lab. Security (on first registration) will be refundable.

Ph.D Degree Programme

GENERAL

These rules apply on all Ph.D. Programmes in which the UET Mardan will be sole degree awarding authority. The Ph.D. programme shall extend over a period of 03 to 08 years as specified by Higher Education Commission of Pakistan. 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, ASARB 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, as per university policy.

All research work will be carried out at UET, Mardan, 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.

b) The Director Admission 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 (k).

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 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.

i) A Ph.D. student may be allowed to register in an advanced Postgraduate course as a single participant with the approval of the Dean.

j) No supervisor shall have more than five (05) candidates for Ph.D. simultaneously, unless authorized by a committee comprising the Dean, the Head of Department and the Director ASARB.

k) The candidates seeking admission in Ph.D. Programme must have:

   (i) A Masters/M.Phil/ equivalent degree in the related field with minimum CGPA 3.0 out of 4.0 or 3.75 out of 5.0 or First Division in annual system. The percentage will be valid only if the CGPA is not mentioned

in the degree/transcript.

(ii) 18 years of education.

(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.

l) Interpretation of these rules and regulations by the authorized officers of the University shall be final.

If the university, remain closed due to the COVID-19 pandemic till 1st August-2020 and ETEA does not conduct the entry test, in that case the following criteria will be used for determining the merit for admission in the PhD Programs of UET Mardan:

Criterion	Weightage
CGPA or Marks Obtained in M.Sc.	40%
Marks obtained in Departmental Entry Test*	60%

***Note:** The Departmental Entry Test will be conducted in university premises for all the departments on alternate days by keeping the strict COVID-19 guidelines in practice. Passing marks for the subject test will be as per HEC guidelines.

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) All students must be available for a minimum period of two years as full time regular student taking leave from their jobs.

c) 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 ASARB 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, Mardan.
(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 recommend that the student may continue his PhD if it is satisfied with the annual progress of his/her work or to discontinue his PhD at any stage if it is not satisfied. In any case the report on satisfactory or un-satisfactory annual progress of the student will be submitted by the chairman of the REC (i.e. supervisor) to the university authorities through director postgraduate studies.

2.3 Examination

2.3.1 Ph.D. Qualifying Examination

a) Each department shall conduct Ph.D. qualifying examination on a regular basis. It will be a written exam on pass/fail basis designed to test knowledge of basic principles in core areas relevant to the candidate's research field.

b) A Ph.D. student must appear in the qualifying examination within six months of the date of his course completion. Students who fail will be allowed to repeat the examination once only within six months of the declaration of qualifying examination result.

c) Students who fail the Qualifying examination twice will not be allowed to continue their Ph.D.

d) The Qualifying Examination Committee should comprise of 3 members including concerned Ph.D. Supervisor. The members of Qualifying Examination Committee will be nominated by the concerned supervisor and appointed by the Chairman of the respective department by taking into consideration the core areas of the research. All the members will assess and evaluate the potential of the student independently with regard to the initiative of Ph.D. research in the relevant field. The Qualifying Examination Committee shall declare the result of the student on pass/fail.

2.3.2 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 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 it to the office of ASARB 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.

2.3.3 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 ASARB 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.

2.3.4 Foreign Thesis Evaluation

a) Two Foreign Thesis Evaluators from technologically advanced countries will be nominated by the supervisor concerned for a Ph.D. student. The supervisor will submit nomination to the Director Postgraduate Studies who will recommend these names to Dean for final approval of vice-chancellor.

b. 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/her thesis, (No correction),

OR

(ii) That the thesis may be resubmitted by the candidate after revision on the proposals suggested by the members,

OR

That the thesis be rejected as it is not of merit and candidate be declared ineligible

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.

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 viva-voce, 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 ASARB shall recommend to the vice-chancellor for appointing a neutral examiner whose opinion shall be final.

e) Publication of at least one research paper in an HEC approved journal (X or W Category) 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) 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 ASARB 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 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.

2.7 Cancellation of Admission

1. A bona-fide student of the University may apply in person, or through parents/ guardians for cancellation of admission on a non-judicial stamp paper worth Rs.50/- duly attested by an Oath Commissioner. The Chairman of the concerned department shall cancel the admission of the student and notify the same.

2. In case, the admission of 1st semester student is cancelled due to any reason, the rules regarding University fee/dues chargeable/ refundable mentioned in the university fee section of the postgraduate prospectus 2020-21 will be applicable. Whereas in all other cases, all outstanding dues/fees etc. till date must be paid.

3. A bona-fide student of the University who joins any other Department/Intuition or Academy for the purpose of study shall be liable for immediate cancellation of his/her admission. In such case only the Library & Lab. Security (on first registration) will be refundable.

Conduct, Discipline, Rules and Regulations

1. RULES AND REGULATIONS

The University Discipline Committee (UDC) established under the Khyber Pakhtunkhwa Universities Model Statues, 2016 shall have the authority and power to deal with, and decide all cases of indiscipline, in accordance with the University Students Conduct and Discipline Rules and Regulations.

2. APPLICABILITY AND COMMENCEMENT

These rules shall be applicable to all the students of UET Mardan and shall commence w.e.f. their admission in the university.

3. STUDENTS CODE OF HONOR

Each and every individual student shall:

(a) show loyalty in their religious duties and respect the opinions of others in matters of religion, integrity and customs.

(b) be truly loyal to Pakistan, and stay away from doing anything that can reduce its honor and reputation in any way.

(c) be honest and trustworthy in dealing.

(d) show respect and care for seniors and show politeness to all, especially to women, children, old people, weak, deformed and the helpless.

(e) respect their teachers and staff in the University.

(f) be conscious of cleanliness of body, mind, speech and habits.

(g) assist their colleagues.

(h) show dedication to studies and extra-curricular activities.

(i) protect government's property.

4. FORBIDDEN AND INDESCIPLINE ACTS

Students should refrain from:

(a) Smoking within the University premises.

(b) Using, carrying or facilitating prohibited drugs and drinks within the University Campus or University Hostels or during training, sports or cultural tours, survey camps or entering such places or attending any such tour of camp while under the influence of such intoxicants, or any other University functions outside the Campus.

(c) Organizing or taking part in any function within the University Campus or hostels or organizing any club or society of students or students' associations, unions and federations, except in accordance with the prescribed rules and regulations.

(d) Gathering money, receiving funds for, or on behalf of the University, except with the written approval of the Vice-Chancellor.

(e) Performing, inciting or contributing in any walk-out, strike, or other form of agitation against the University or its teachers or officers, inciting anyone to violence, or disrupting the peaceful atmospheres of the University in any way. Moreover, making of offensive speeches or gestures which may cause hatred shall be avoided. Issuing of pamphlets or cartoons casting criticisms 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 or social media platforms, making false accusations or lowering the prestige of the University or writing and pasting posters on the walls.

(f) Carrying firearms or any other weapon (of any nature/type) forbidden by law, within the University Campus, classrooms, hostels and offices.

(g) Violates the lawful instructions of a teacher or other person in authority in the University

(h) Causing damage to the property of the University or public or a fellow student or any teacher or any employee of the University.

(i) Using of loud speakers in the University Campus or hostels.

(j) Not obeying the rules concerning to residence in hostels, or using offensive language, wearing immodest clothes, making indecent

remarks or gestures, or behaving in a disorderly manner, or committing any criminal immoral or shameful act (whether committed within the University Campus or outside) or any act which is detrimental to the interest of the University. Doing false representation or giving false information or willfully suppressing facts, cheating or deceives the University.

(k) Falsifying, damaging, altering or erasing or otherwise meddling with any document connected with examination, receipt of University fees / dues or making undue use of such documents.

6. PROCEDURE IN CASE OF BREACH OF DISCIPLINE

6.1 Cases of indiscipline shall be reported to the Vice-Chancellor through the concerned head of department/section.

6.2 The Vice-Chancellor may refer the case to the University Discipline Committee (UDC) for necessary action under the Rules/ Regulations.

6.3 The UDC may impose, with the approval of Vice-Chancellor, minor/major penalties including to fine, suspend, expel or rusticate students on the basis of the enquiry conducted in response to violation of rules and regulations of the University.

6.4 The appellate authority for the decisions of UDC shall be the Vice-Chancellor.

7. RUSTICATION AND EXPULSION

7.1 Rustication

i. Rustication, whenever forced on a University student, shall always mean the loss of one semester or one academic year of the student.

ii. During the rustication period, the student shall not be allowed to register any course in the University or sit in any examination.

iii. No fee will be charged from a rusticated student for the duration in which his/her name is struck off the rolls.

iv. If a student is rusticated during a running semester and has paid the University fee for that semester, he/she will have to repeat that semester upon expiry of the rustication period. However, he/she shall not be required to pay the University fee for that semester again.

7.2 Expulsion

i. The expiration period will be counted from the date of the issue of such notice from the University.

ii. Expulsion period can vary.

iii. 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.

iv. A student expelled from a Department may be re-enrolled into that Department after the expiry of the period of expulsion.

v. Cases of expulsion will be registered in the University and notified to all Departments and Universities.

8. GENERAL

(i) The authority, which has the power to rusticate could also withdraw the same order before the expiry of the period.

(ii) No student shall be rusticated/expelled from the University unless he has been served with the Show Cause Notice, and shall be allowed a reasonable time for clarification and reply to the charges framed against him.

(iii) When in the view of the Discipline Committee, the rustication or expulsion is not called for in a case referred to it, may impose any other penalty or penalties mentioned in the above Regulations.

9. APPEAL

(i) An appeal in contradiction of the punishment awarded by the University Discipline Committee (UDC) can be made to the Appellate Committee.

(ii) No appeal by a student against the decision of the University Discipline Committee (UDC) 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.

10. OFFENCES AND PENALTIES

University authorities can impose the following Penalties for various violations committed:

Table-10.1: Offences and Penalties

S.No.	OFFENSE	PENALTY
1.	Using alcoholic drinks or carrying 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 or outside the campus under the influence of such intoxicants or disobedience with others, especially females, during tours etc.	Expel from classes for one week or fine not above Rs. 10,000/OR Discharge from the University
2.	Taking part in or organizing any function within the University Campus or hostel or organizing any society of students or student's association, unions or federation, except in accordance with the prescribed rules and regulations.	Strict warning and / or Fine not beyond Rs. 20,000/-, AND / OR Expulsion from hostel accommodation, if relevant.
3.	Assembling any money or collecting funds for or on behalf of the University, except with the written permission of the Vice-Chancellor.	All the collected money shall be confiscated in favor of the University. AND/OR Fine not exceeding Rs. 10,000/
4.	Forcing fellow students to a walkout from classes or examination halls or organizing, leading 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.	Using abusive and derogatory language or aspersion remarks in speeches, brochures or posters against the University authorities or members of teaching or administrative staff of the University or substantially 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.	Discharge from the University for one to six semesters/ three years, depending on the nature of the crime. AND / OR Fine not exceeding Rs. 30,000/
6.	Participating or conducting a violent attack on the offices of the University authorities, Chairmen, faculty members or other officers/staff of the University.	Permanent expulsion from the University. AND / OR Fine not exceeding Rs. 50,000/
7.	Damaging/destroying or attempting 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 classrooms 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 student communities 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/staff members.	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, religious 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/-
14.	The University does not tolerate discrimination or harassment on the basis of gender. When the University becomes aware of gender-based harassment or discrimination, the University will take steps to end the conduct, prevent its recurrence, and address its effects on the individual and community. The University proctorial board is authorized with reviewing and evaluating conduct and harassment processes and outcomes and making recommendations to the University Discipline Committee (UDC) for onward action.	As per recommendations of the UDC

11. STUDENTS' GRIEVANCES REDRESSAL

If a student has grievances against any department/section/center/directorate/office or employee of the University, he/she can submit a complaint to the Director Quality Enhancement Cell (QEC) on prescribed form available at the Directorate of QEC and download section of the University website (www.uetmardan.edu.pk).

University of Engineering & Technology, Mardan