Curriculum for
Telecom Engineering/
Electrical Engineering
(Telecom)
Bachelor of Engineering Program
2020

Pakistan Engineering Council
&
Higher Education Commission
Islamabad
CURRICULUM
OF
TELECOM ENGINEERING / ELECTRICAL ENGINEERING
(Telecom)
Bachelor of Engineering Program
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PREFCE

The curriculum, with varying definitions, is said to be a roadmap or plan of teaching-learning process that students of an academic program are required to undergo. It includes objectives and learning outcomes, course contents, scheme of studies, teaching approaches, and assessment methodologies. Since knowledge in all fields and sectors is expanding at a faster pace and new disciplines are also emerging; it is imperative that curricula should be dynamic having regular review and updation.

The University Grants Commission (UGC) was the designated authority to develop, review and revise curricula beyond Class-XII vide Section 3, Sub-Section 2 (ii), Act of Parliament No. X of 1976 titled “Supervision of Curricula and Textbooks and Maintenance of Standard of Education”. With the repeal of UGC Act, the same function was assigned to the Higher Education Commission (HEC) under its Ordinance of 2002, Section 10, Sub-Section 1 (v). In compliance with the above provisions, the HEC has been undertaking the development of curricula for new/ emerging fields and revision of curricula after regular intervals through respective National Curriculum Revision Committees (NCRCs) until 2018.

As a policy change and expanding higher education base under HEC, the curriculum review and development task has been shifted to the respective regulators and HEIs. PEC also having mandate under its Act of Parliament and especially after attaining Washington Accord full signatory status and IPEA licensing authority, took up the challenge to review and develop the curricula for engineering programs based on Outcome-Based Education (OBE) System. PEC has therefore constituted an Engineering Curriculum Review and Development (ECRDC) and also subject ECRDCs comprising of eminent engineers and professionals from academia and industry to take up the task of curricula review and updation. Nevertheless, the basic templates developed by HEC NCRCs have been followed as guidelines.

Under OBE based curriculum review and development framework, PEC held national and regional levels stakeholders and industrial consultation workshops engaging HEIs, industry, technical and consulting organizations. The experts’ feedback and suggestions were translated into the curriculum review process taking into consideration of the dynamics of technological advancement, industrial needs and management-cum-soft skills for engineering graduates.
This curriculum document would therefore serve as a guideline whereas allowing HEIs to tame/ change within the framework by introducing courses in support of local/ required industrial demand as well as satisfying 12 GAs (Graduate Attributes) covering core and elective courses, considered as beauty of OBE system in the international environment. At the same time, this curriculum framework would fulfill our national, social and economic needs leading towards attainment of Sustainable Development Goals (SDGs-2030). It would also provide the level of competency specified in Pakistan Qualification Framework to make it compatible with international educational standards.
1. Engineering Curriculum Review & Development Committee (ECRDC)

PEC in its efforts towards quality engineering education, took up the challenge of curriculum review and development for engineering programs after due consent of HEC. A high level Engineering Curriculum Review and Development Committee (ECRDC), led by Prof Engr Dr Fazal Ahmad Khalid, Chairman Punjab HEC/ Vice Chairman PEC, was constituted whereas other eminent members are from industry and academia to take up the task of curricula review and updation, besides developing curriculum for new/ emerging fields. The main responsibility of ECRDC is to oversee the entire curriculum review and development process while setting policies and guidelines for the subject ECRDCs working in their respective domains. The 1st meeting of main ECRDC was held on 29th June, 2018 at PEC HQ, Islamabad, wherein the Convener briefed the scope, objective and ToRs of the Committee and also formulated the subject ECRDCs comprising of eminent engineers and professionals from academia and industry.

1. Engr Prof Dr Fazal Ahmed Khalid
   Convener, Metallurgy, Materials, Mining Engg & Allied Disciplines

2. Engr Prof Dr M. Younus Javed
   Convener Electrical Engg & Allied Disciplines

3. Engr Malik Saleem Ullah Saeed
   Convener Chemical Engg & Allied Disciplines

4. Engr Dr Wasim Khaliq
   Convener, Civil Engg & Allied Discipline

5. Engr. Prof. Dr. Iftikhar Hussain
   Convener, Mechanical and Allied Engineering

6. Engr Dr Muhammad Ashraf
   Convener, Agricultural Engg & Allied Disciplines

7. Engr Prof Dr Jameel Ahmed
   Convener, Common to All (Non-Engg Component)
Curriculum of Telecom Engineering / Electrical Engineering (Telecom)

8. Engr Muhammad Raza Chohan  
   Director General, HEC  
   Member

9. Engr Dr Nasir Mahmood Khan  
   Additional Registrar (Accreditation), PEC  
   Member

10. Engr Dr Ashfaq Ahmed Sheikh  
    Additional Registrar, CPD  
    Secretary

2. ECRDC Agenda

- The ECRDC is responsible to oversee the overall working of curriculum review and development for all engineering programs in terms of strategy, guidance and progress and thereby submission to the relevant forum for adoption/ notification.

- Each Member of ECRDC will also work in the capacity of Convener for respective disciplines as mentioned against their names and as per their ToRs.
3. **OBE-Based Curriculum Development Framework**

Outcome Based Education (OBE) is an approach of teaching and learning that focuses on what students should be able to attain at the end of the educational program. OBE is a student’s centered system which concerns what the students will know and be able to do as learning outcomes. The curriculum development under OBE is therefore an integration of graduate attributes and stakeholders’ feedback in cognizance with institution’s Vision and Mission.

**Outcome-Based Education (OBE) - Curriculum Development Framework**
4. PDCA Approach to Curriculum Development

The process of curriculum design and development constitutes various interconnected elements with the objective of achieving the intended purpose of the program. The Plan-Do-Check-Act approach (PDCA) as explained below has been followed in the curriculum development and review process.

**Plan.** This stage begins with an analysis of the stakeholders' needs of faculty, current and past students, employers and society in general. The stakeholders' needs are translated into human resource terminology i.e. graduate competencies which in turn translated into educational taxonomy and learning outcomes. Based on the learning outcomes, curriculum is designed backward to meet PLOs.
**Do.** The plan stage is implemented where curriculum is delivered and learning outcomes are assessed to gauge the achievement of PLOs.

**Check.** This stage involves the analysis of assessment results and feedback from students and faculty. Areas for improvement are identified.

**Act.** When the learning outcomes are achieved, the curriculum, learning and teaching strategies and assessment methods are standardized. Best practices are shared and improvement is made for the next cycle of PDCA.

## 5. ECRDC for Electrical & Allied Engineering Disciplines

The PEC Engineering Curriculum Review and Development Committee (ECRDC) of Electrical and Allied Engineering Disciplines took up the task to review and update the curriculum for Bachelor of Telecom Engineering degree program. The subject Committee had meetings on 18-9-2019 and 20-2-2020 besides meetings of Sub-Group Telecom Engineering on 15-11-19 and 5-12-2019 at PEC Headquarters Islamabad. The Committee consisted of following members:

1. Engr Prof Dr M. Younus Javed  
   Vice Chancellor  
   HITEC University, Taxila  
   Convener

2. Engr Dr Saeed Ur Rehman  
   Executive Director  
   Sir Syed CASE Institute of Technology, Islamabad  
   Member

3. Engr Zafar Mehmood  
   Chief Executive Officer  
   InterSES (International System Engineering and Services Pvt. Ltd) Islamabad  
   Member

4. Engr Prof Dr Suhail Aftab Qureshi  
   Professor, Ex Dean  
   University of Engineering & Technology, Lahore  
   Member
5  Engr Prof Dr Usman Akram
   Associate Professor
   Department of Computer & Software Engineering
   NUST College of Electrical & Mechanical Engineering
   Rawalpindi

6  Engr Yasir Rizwan Saqib
   Chief Executive Officer
   TechFoot, Lahore

7  Engr Prof Dr Jameel Ahmed
   Dean
   Faculty of Engineering & Applied Sciences
   Riphah International University, Islamabad

8  Engr Mairaj Gul
   General Manager Operations North
   National Telecommunication Corporation, NTC HQs, Islamabad

9  Engr Prof Mansoor Shaukat
   Assistant Professor
   School of Electrical Engineering & Computer Science (SEECS)
   National University of Sciences and Technology (NUST)
   Islamabad

10 Engr Prof Dr Bhawani Shankar Chowdhry
    Ex Dean, Faculty of Electrical, Electronics & Computer Engg
    Mehran University of Engg & Technology, Jamshoro

11 Engr. Prof. Dr. Mohammad Inayat Ullah Babar
    Vice Chancellor
    University of Engineering & Technology, Taxila

12 Engr Prof Dr Madad Ali Shah
    Vice Chancellor
    The Benazir Bhutto Shaheed
    University of Technology and Skill Development
    Khairpur Mirs, Sindh
13 Engr. Muhammad Roshan Awan  
Principal  
Govt. College of Technology, Taxila  

14 Engr. Habib Ur Rehman Qaiser  
Lt. Colonel Army (Rtd), Lahore  

15 Dr. Mohammad Ali Maud  
Professor  
Department of Computer Engineering UET, Lahore  

16 Engr Prof Dr Vali Uddin  
Professor, Department of Electronics  
Hamdard University, Karachi  

17 Engr. Prof. Engr Dr. Nisar Ahmed  
Professor  
Ghulam Ishaq Khan Institute of Engg, Sciences & Technology Swabi  

18 Engr Prof Dr Waqar Mahmood  
Director  
Al-Khawarizmi Institute of Computer Science  
UET, Lahore  

19 Engr Dr Ismail Shah  
Ex-Chairman  
Pakistan Telecommunication Authority, Islamabad  

20 Dr Shazia Nauman  
Associate Professor  
Riphah International University, Islamabad  

21 Engr Mohsin Latif  
Entrepreneur, Vital Imaging, Karachi  

22 Engr Asif Mehmood  
Director NESCOM, Islamabad  

23 Engr. Porf Dr. Syed Mohammad Hasan Zaidi  
School of Electrical Engineering and Computer Engineering (SEECS), Islamabad  

Member
24 Engr. Dr. Tauseef Tauqeer
   Associate Professor
   Information Technology University, Lahore

25 Engr. Dr. Zahir Paracha
   Professor, Department of Electrical Engineering
   Pakistan Institute of Engineering & Technology, Multan

26 Mr. Hidayatullah Kasi
   Deputy Director
   Higher Education Commission, Islamabad

27 Engr. Dr. Ashfaq Ahmed Shaikh
   Additional Registrar-CPD
   Pakistan Engineering Council, Islamabad

28 Engr. Muhammad Kashif Ali
   Assistant Registrar-CPD
   Pakistan Engineering Council, Islamabad

5.1 Sub Group Telecom Engineering

1. Engr. Dr. Syed Mohammad Hasan Zaidi
   Professor, NUST School of Electrical Engineering
   and Computer Engineering (SEECS), Islamabad
   Lead Sub-Group

2. Engr. Muhammad Roshan Awan
   Principal
   Govt. College of Technology, Taxila
   Member

3. Engr. Habib Ur Rehman Qaiser
   Lt. Colonel Army (Rtd)
   Lahore
   Member

4. Engr. Dr. Ismail Shah
   Ex-Chairman
   Pakistan Telecommunication Authority, Islamabad
   Member

5. Engr. Dr. M. Imran
   Department of Electrical Engineering
   Military College of Signals (MCS), Rawalpindi
   Member
6. **Engr. Dr. Fasih ud Din Butt**  
   Department of Electrical Engineering  
   Comsats Islamabad Campus, Islamabad  
   *Member*

7. **Engr. Dr. Ali Hassan**  
   NUST School of Electrical Engineering and Computer Engineering (SEECS), Islamabad  
   *Expert*

8. **Engr. Dr. Danish Ali Mazhar**  
   Senior Instructor Telecom  
   TEVTA, Taxila  
   *Expert*

9. **Mr. Hidayatullah Kasi**  
   Deputy Director  
   HEC, Islamabad  
   *Rep HEC*

10. **Engr. Dr. Ashfaq Ahmed Shaikh**  
    Additional Registrar-CPD  
    Pakistan Engineering Council, Islamabad  
    *Secretary*

11. **Engr. Muhammad Kashif Ali**  
    Assistant Registrar-CPD  
    Pakistan Engineering Council, Islamabad  
    *AR-CPD*
6. Agenda of ECRDC for Electrical and Allied Engineering Disciplines

- The Subject ECRDC will work under the overall directions and supervision of main ECRDC comprising all Conveners.
- The key driving lines for the development of engineering curriculum for each discipline will be the overall policy of Pakistan Engineering Council in connection with international commitments (Washington Accord, IPEA etc.) and Government policies/HEC.
- Review of policies and stakeholders’ feedback for the sector(s) relevant to the respective discipline
- Comparative study of the curricula being offered at various engineering universities/institutions following the OBE-based system
- Development and finalization of complete scheme and curriculum for respective discipline including all aspects.

Engr. Prof. Dr. Muhammad Younis Javed, the Convener highlighted the important benchmarks and international best practices to be considered for the revision of the curriculum while taking into account the Outcome Based Education (OBE) system. He also apprised that the Committee comprising professionals and experts from academia, industry and R&D institutions, has provided useful input and suggestions covering new developments to be incorporated in the curriculum. He also highlighted the importance of the field of Telecommunication Engineering for achieving sustainable developments while addressing socio-economic issues and challenges envisaged in Sustainable Development Goals (SDGs) as under and well-mapped with the courses;

- Goal-1: No Poverty
- Goal-2: Zero Hunger
- Goal-3: Good Health and Well-being
- Goal-4: Quality Education
- Goal-5: Gender Equality
- Goal-8: Decent Work and Economic Growth
- Goal-9: Industrial Innovation and Infrastructure
- Goal-12: Responsible Consumption and Production
• Goal-13: Climate Action

The curriculum therefore has been designed based on above SDGs translating into program objectives and mapped with the scheme of study.
7. Program Educational Objectives (PEOs) and Learning Outcomes (PLOs)

As guidance, the sample Program Educational Objectives (PEOs) and Learning Outcomes (PLOs) are given below for a typical Telecom Engineering Program. The HEIs should have their own program objectives (PEOs) and PLOs in line with the institution’s Vision and Mission, in cognizance with industrial needs as well as national and international trends.

7.1 Program Educational Objectives (PEOs)

The program aims at imparting quality education to Telecom Engineering graduates for contributing to the society through modern technologies and practices in line with SDGs especially Goal-1, Goal-2, Goal-3, Goal-4, Goal-5, Goal-8, Goal-9, Goal-12, and Goal-13.

The graduates of the program will develop into professional engineers who will:

- Demonstrate excellence in profession through in depth knowledge and skills in the field of Telecommunication Engineering
- Engage in continuous professional development and exhibit quest for learning, innovation and entrepreneurship
- Show professional integrity and commitment to social and ethical responsibilities

7.2 Program Learning Outcomes (PLOs)

Program outcomes are the narrower statements that describe what students are expected to know and be able to do by the time of graduation. These relate to the knowledge, skills and attitude that the students acquire while progressing through the program. Specifically, it is to be demonstrated that the students have acquired the following graduate attributes (GAs):

PLO-01: Engineering Knowledge: Ability to apply knowledge of mathematics, science and engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PLO-02: Problem Analysis: Ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PLO-03: Design/Development of Solutions: Ability to design solutions for complex engineering problems and design systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

PLO-04: Investigation: Ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.

PLO-05: Modern Tool Usage: Ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.

PLO-06: The Engineer and Society: Ability to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solution to complex engineering problems.

PLO-07: Environment and Sustainability: Ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of, and need for, sustainable development.

PLO-08: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PLO-09: Individual and Team Work: Ability to work effectively, as an individual or in a team, on multifaceted and/or multidisciplinary settings.

PLO-10: Communication: Ability to communicate effectively, orally as well as in writing on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentations, make effective presentations, and give and receive clear instructions.

PLO-11: Project Management: Ability to demonstrate management skills and apply engineering principles to one’s own work, as a member and/or leader in a team to manage projects in a multidisciplinary environment.
PLO-12: Lifelong Learning: Ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments.

8. Program Salient Features

The undergraduate engineering program has been based on the following salient features:

- **Duration:** 4 years
- **Number of Semesters:** 8
- **Total number of credit hours:** 130 - 136
  - Engineering Domain: minimum 85 Credit Hours
  - Non-Engineering Domain: minimum 30 Credit Hours

(HEIs have flexibility of 15-21 Credit Hours to add courses either in Engineering, Non-Engineering or both Domains to fulfill the program objectives in line with the overall Vision/Mission of the Institute concerned).

- **Additional Course or Credit Hours Requirements:** Any addition of course or credit hour requirements as per direction or policy of the Government (Provincial or Federal), HEIs have leverage to cater such needs over and above the prescribed requirements in this document.

- **Number of weeks per semester:** 15 - 18
- **Number of credit hours per semester:** 15 - 18

- **Curriculum:** The engineering curriculum is the most important instrument for grooming the students based on 12 Graduate Attributes (GAs) encompassed under the Program Learning Outcomes (PLOs). In order to inculcate different dimensions of thinking – mathematical, computational, design and creative – among students in Cognitive, Psychomotor and Affective domains, the curriculum is based on the following knowledge profiles:

  **WK1 - Natural Sciences:** A systematic theory-based understanding of natural sciences applicable to the discipline.
WK2 - Mathematics and Computing: The concept-based mathematical thinking, numerical analysis, statistics and formal aspects of computer and information science to support analysis and modeling applicable to the discipline.


WK4 - Engineering Specialization: The knowledge of engineering specialization that provides theoretical frameworks and bodies of knowledge for the accepted practice areas that are at the forefront in a discipline.

WK5 - Engineering Design: The Design Thinking Knowledge that supports engineering design in a practice area of an engineering discipline.

WK6 - Engineering Practice: The Knowledge of engineering practices (technology) in different practice areas of an engineering discipline.

WK7 - Engineering in Society: A systematic, comprehension-based knowledge of the role of engineers in a society and the professional issues related to practicing engineering profession in a discipline: ethics and the professional responsibility of an engineer to public safety including the impact of an engineering activity i.e. economic, social, cultural, and environmental and sustainability

WK8 - Research Literature: Engagement with selected knowledge in the research literature of the discipline.

The curriculum matrix covering above knowledge profiles should therefore be composed of non-engineering domain (humanities, math, management and natural sciences), and engineering domain with computer science, foundation, breadth, depth and multidisciplinary courses (including safety) so that different streams could be encouraged within each discipline, enabling students to undertake a range of Complex Problem Solving and Complex Engineering Activities. The students
may select electives from any of the streams with guidelines from their respective advisors.

<table>
<thead>
<tr>
<th>Knowledge Profile* (WK-1 to WK-8)*</th>
<th>Knowledge Area</th>
<th>Sub-Area</th>
<th>Courses</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-Engineering Domain</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WK-2</td>
<td>Natural Science</td>
<td>Math</td>
<td>As per program requirements</td>
<td>12 - 15</td>
</tr>
<tr>
<td>WK-1</td>
<td>Natural Science</td>
<td>Physics</td>
<td>Applied Physics</td>
<td>6 - 9</td>
</tr>
<tr>
<td>WK-1</td>
<td>Natural Science</td>
<td>Chemistry</td>
<td>Applied Chemistry</td>
<td></td>
</tr>
<tr>
<td>WK-1</td>
<td>Natural Science</td>
<td>Math Elective</td>
<td>As per program requirements</td>
<td></td>
</tr>
<tr>
<td>WK-7</td>
<td>Humanities</td>
<td>English</td>
<td>Written, communication and presentation skills</td>
<td>4 - 7</td>
</tr>
<tr>
<td>WK-7</td>
<td>Humanities</td>
<td>Culture</td>
<td>Islamic Studies and Ethics</td>
<td>2</td>
</tr>
<tr>
<td>WK-7</td>
<td>Humanities</td>
<td>Culture</td>
<td>Pakistan Studies and Global Perspective</td>
<td>2</td>
</tr>
<tr>
<td>WK-7</td>
<td>Humanities</td>
<td>Social Science</td>
<td>Social and soft skills</td>
<td>2 - 6</td>
</tr>
<tr>
<td>WK-7</td>
<td>Management Sciences</td>
<td>Professional Practice</td>
<td>Professional and Project Management</td>
<td>2 - 6</td>
</tr>
<tr>
<td><strong>Total (Non-Engineering Domain)</strong></td>
<td></td>
<td></td>
<td></td>
<td>min 30</td>
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<tr>
<td><strong>Engineering Domain</strong></td>
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<tr>
<td>WK-3/ WK-2</td>
<td>Foundation Engg Courses</td>
<td>Specific to program objectives and outcomes</td>
<td>22 - 24</td>
<td></td>
</tr>
<tr>
<td>WK-4/ WK-2/ WK-1</td>
<td>Core Breadth of Engg discipline</td>
<td>Specific to program objectives and outcomes</td>
<td>23 - 24</td>
<td></td>
</tr>
</tbody>
</table>
### Bachelor of Engineering Program (2020)

<table>
<thead>
<tr>
<th>WK-5/ WK-6</th>
<th>Core Depth of Engg Discipline</th>
<th>Specific to program objectives and outcomes</th>
<th>22 - 24</th>
</tr>
</thead>
<tbody>
<tr>
<td>WK-1/ WK-2/ WK-3/ WK-4</td>
<td>Multi-disciplinary Engg Courses</td>
<td>Specific to program objectives and outcomes</td>
<td>6 - 12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Occupational Health and Safety (mandatory – 01 Cr Hr)</td>
<td></td>
</tr>
<tr>
<td>WK-6/ WK-8/ WK-7</td>
<td>Final Year Design Project (FYDP/ Capstone)</td>
<td>Integration of innovative, creative, technical, management and presentation skills of a graduate towards final year.</td>
<td>6</td>
</tr>
<tr>
<td>WK-6/ WK-7</td>
<td>Industrial Training</td>
<td>at least 6 - 8 weeks internship</td>
<td>Qualifying</td>
</tr>
<tr>
<td></td>
<td>- Complex Problem Solving</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Complex Engineering Activities</td>
<td></td>
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<td></td>
<td>- Semester Project</td>
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<tr>
<td></td>
<td>- Case Studies</td>
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<tr>
<td></td>
<td>- Open Ended Labs</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>- Problem Based Learning (PBL)</td>
<td></td>
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</tbody>
</table>

| Total (Engineering domain) | min 85 |
| Total (Credit Hours) | 130 - 136 |

* As a specific or more than one knowledge profile to be covered.

- **Industrial Training**: Internship of at least 6 - 8 weeks is mandatory part of degree requirements towards 3rd to 4th year of program; must be supervised, monitored, evaluated, and reflected in the transcripts under a prescribed mechanism and with defined and mapped rubrics with program objectives;
  - Selection of internship in line with elective subjects/ specific streams
  - Qualifying weightage:
    - At least 75% attendance is mandatory 10%
    - Assessment report from the employer 50%
    - Evaluation at relevant HEIs/ Deptt – presentation 40%
- **Final Year Design Project (FYDP)/ Capstone:** FYDP aims to challenge innovative, creative, technical, management and presentation skills of a graduate to bring together the learning over the degree program.
  
  - A final year design project (FYDP) is the confluence of an engineering program. Undertaking a final year design project is a compulsory requirement. It should mainly comprise literature search, individual analysis, modeling and simulation, AI (Artificial Intelligence) and computational data analytics, design and putting together various hardware, software, firmware and Algorithm Engineering / Informatics related to the program to demonstrate a functional concept including rapid prototyping, where applicable.
  - The FYDP shall include complex engineering problems and design systems, components or processes integrating core areas and meeting specific needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
  - A project of this nature should invariably lead to an integration of the knowledge and practical skills as mandated in the program outcomes. In this context, projects of multidisciplinary nature should be encouraged.
  - The FYDP should span over two consecutive semesters, i.e. semester 7 & 8, totaling 6-credit hours and should be fully supervised, assessed and reflected in the transcripts under a prescribed mechanism so as to prepare for joining industry after graduation.

- **Faculty:** The faculty must be trained for the Outcome-Based Education (OBE) system. Their familiarity with the program objectives and outcomes, understanding of the Outcome-Based Assessment (OBA) cycle, enthusiasm for developing an effective program, and the ability to become an active player in this regard are the keys to ensure the attainment of program objectives. The faculty is expected to have the ability to ensure proper implementation of the program, and to develop processes for evaluation, assessment and CQI. A formal training program to groom the faculty should be instituted to become effective instructors in applying pedagogical skills in all aspects of Teaching, Learning and Assessment covering all domains of Knowledge, Skills and Attitude.
• **Personal Grooming:** Personal Grooming of young faculty members and students is very important in order to develop and support their professional skills. Therefore, it is required that HEIs should conduct/arrange sessions or counseling hours on regular basis to provide guidance for personal grooming. Personal Grooming is important for positive self-image and increasing the confidence level of the individuals. It would help in enhancing students’ self-esteem and would go a long way in developing an attractive personality by adopting habits like personal hygiene, clothing, appearance, interaction and expressive skills, etc. The students should be motivated and equipped to be entrepreneurs in their relevant field.

• **Presentation and Communication Skills:** Special focus should be given to inculcate communication and presentation skills amongst the graduates through individual and group presentations, technical writing and discussions, throughout the program as a regular feature.

This curriculum has been designed to guide and facilitate the universities and departments to formulate their own programs according to the industrial needs, emerging trends and recent developments in the field of Telecom Engineering. The HEIs have flexibility to incorporate changes in the proposed curriculum within given range of credit hours for engineering and non-engineering domain.
9. Framework for Bachelor of Telecommunication Engineering

<table>
<thead>
<tr>
<th>Knowledge Profile (WK-1 to WK-8)</th>
<th>Knowledge Area</th>
<th>Sub Area</th>
<th>Course Title</th>
<th>Theory</th>
<th>Lab</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-Engineering Domain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>WK-7</td>
<td>Humanities</td>
<td>English</td>
<td>Functional English</td>
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**Total (Engineering Domain)**  

| Credit Hours | 69 | 27 | 96 |

**Total Credit Hours**  

| Credit Hours | 108 | 28 | 136 |

* to be taught during 1st year of program.
# 10. Scheme of Study for Bachelor of Telecommunication Engineering

## Semester 1

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| Grand Total | 107 | 28 | 135 |
Curriculum of Telecom Engineering / Electrical Engineering (Telecom)

Computer and Information System Courses

- Information and Communication Technology
- Object Oriented Programming
- Computer Aided Design
- Object Oriented Programming
- Artificial Intelligence
- Computer Programming
- Introduction to Modelling & Simulation

Major Based Core (MBC) Depth Electives (Proposed)

- Multimedia Systems
- Satellite Communications
- Telecom Standards and Regulations
- Telecom Traffic Engineering
- Next Generation Networks
- Network Security
- Radar Systems Engineering
- Telecommunication Network Management
- Machine learning for Communication Systems

Multi-Disciplinary Electives (Proposed)

- GIS/RS applications in Telecom
- Operating Systems
- Data structures and algorithms
- VLSI Systems
- Artificial Intelligence
- Big Data Analytics
- Database Management Systems
- Embedded Systems
- Cyber Security
- Data Analytics
- Reliability in Telecommunication Systems
• Cloud Computing
• Internet of Things
• Operations Management
11. Program Specific Labs

The following labs specific to engineering discipline be ensured to cover relevant knowledge domains but not limited to;

- Electric Machines Lab
- Signal Processing Lab
- Data Communication & Internetworking Lab
- Communication Systems Lab
- RF Microwave Lab
- Antenna Lab
- Control & Instrumentation Lab
- Computer Lab
- Project and Research Lab
- PC Labs
12. Course Detail and Teaching-Assessment Approaches

12.1 Engineering Domain

In the following sections, Course Outlines and teaching-assessment approaches are given for guidance based on a typical semester system. The instructors may adopt or adapt accordingly defining CLOs, course delivery plan, innovative teaching approaches and assessment techniques.

Computer and Information System Courses

Information and Communication Technologies (ICT)

Course Outline:

Introducing Computer Systems: Basic Definitions
- Computer and Communication Technology
- The applications of ICT - particularly for Engineers

Basic Operations and Components of a Generic Computer System
- Basic operations: Input, Processing, Output, Storage
- Basic components: Hardware, Software, Data, Users
- Types of storage devices

Processing Data
- Transforming data into information
- How computers represent and process data
- Processing Devices
- CPU architectures

The Internet
- The Internet and the World Wide Web- browsers, HTML
- URLs/ How DNS works
- Email and other programs
Introduction to Embedded Systems

- What is an Embedded System
- Applications
- Components
- Programming Languages
- Popular Development Platforms

Networking Basics

- Uses of networks
- Common types of networks (LAN, WAN, MAN etc.)
- Introduction to OSI Model
- Future of Networks

Database Management

- Hierarchy of Data
- Maintaining Data
- Database Management Systems

Exposure to ICT Tools and Blogs (Student Assignment)

Protecting your privacy, your computer and your data

- Basic Security Concepts
- Threats to users
- Threats to hardware
- Threats to Data

ICT in Education

Future Trends in ICT

Final Presentations

Tools / Software Requirement

Microsoft Office, Windows, Virtual Box, Netbeans
Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:


Computer Programming

Course Outline:

- Introduction to Programming and languages
- Algorithms, Flowcharts and pseudocode
- Overview of programing (C, C+, Python)
- Writing, compiling and debugging
- Coding style
- Statements
- Variables and datatypes
- Operators and expressions
- Selection
- Relational operators
- Conditional Statements
- Conditional operators
- Switch, break, continue
- Logical operators
Curriculum of Telecom Engineering / Electrical Engineering (Telecom)

- Modular programming
- Structures in functions and Arrays
- File pointers
- Error handling
- Revision
- Project Demos

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Code Complete (latest Ed.) by Steve McConnell,

Computer Aided Design

Course Outline:

- Introduction to AutoCAD
- Use basic drawing and text commands
- Use basic editing commands (move, copy, erase, etc.)
- Use advanced editing commands (mirror, fillet, etc.)
- Dimensioning capabilities of Auto CAD
- Create and use layers
- Print or plot a drawing
- Create and using blocks
• Be familiar with hatching capabilities of Auto CAD
• Curves
• 3D modeling
• Multiple Lines
• Geometric Shapes
• Isometric drawings
• Polar Arrays

Teaching Methodology (Proposed as applicable):
Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:
Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:
• AutoCAD® latest edition And AutoCAD Ltd latest edition No Experience required by Donnie Gladfelter.

Introduction to Modeling and Simulation

Course Outline:
Simulation
• Prepare Model Inputs and Outputs
• Configure Simulation Conditions
• Run Simulations
• View and Analyze Simulation Results
• Test and Debug Simulations
• Optimize Performance
• Simulation Guidelines & Best Practices
Modeling

- Design Model Architecture
- Manage Design Data
- Design Model Behavior
- Configure Signals, States, and Parameters
- Configure Inputs and Visualizations
- Analyze and Remodel Design
- Test Model Components
- Modeling Guidelines & Best Practices

Tools/ Software Requirement

- Matlab

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Introduction to Matlab for Engineering Students by David Houcque, Northwestern University latest edition.

Artificial Intelligence

Course Outline

This course gives a broad overview of the fundamental theories and techniques of Artificial Intelligence.

- Overview of AI Problems;
• Intelligent Behavior: Turing Test, Rationale versus Non-rationale Reasoning;
• Problem Characteristics: Fully versus Partially Observable,
• Single versus Multi agent; Intelligent Agents: reactive, deliberative, goal-driven, utility-driven, and learning agents; Uninformed Search: Depth First, Breadth First, Depth First with Iterative Deepening;
• Informed Search: Hill climbing, A*- Search and their Time and Space Complexity, Local Search, Genetic Algorithm; Game Playing: Minimax, Evaluation functions, Alpha-beta pruning; Propositional and Predicate Logic; Resolution and Theorem Proving; Forward and Backward Chaining;
• Machine Learning: Introduction,

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

Object Oriented Programming

Course Outline

- Procedural versus object oriented programming languages,
- Object oriented design strategy and problem solving, pointers, file handling,
- Objects and classes, member functions, public and private members,
- Dynamic memory management,
- Constructors and destructors, templates,
- Object encapsulation, derived classes, class hierarchies,
- Inheritance and polymorphism,
- Operator overloading, stream class,
- Practical design through object oriented programming.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

Engineering Foundation Courses

Electric Workshop

Course Outline

- Topics covered include: Introduction to technical facilities in a workshop including mechanical and electrical equipment, concepts in electrical safety, safety regulations, earthing concepts, electric shocks and treatment, use of tools used by electricians
- Wiring regulations, types of cables and electrical accessories including switches, plugs, circuit breakers and fuses etc.,
- UPS/ invertors and battery charging, industrial, domestic and auto wiring, symbols for electrical wiring schematics, wiring schemes of two-way, three-way and ringing circuits,
- Electric soldering / de-soldering,
- PCB design, transferring a circuit to PCB, etching, drilling and soldering components on PCB.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

Circuit Analysis

Course Outline:

- Topics include: Electric quantities, electric circuits,
- Kirchhoff's laws,
- Circuit elements, resistance, series parallel combination, voltage and current dividers, resistive bridges and ladders,
- Practical sources and loading,
- Instrumentation and measurement,
- Nodal analysis, loop analysis, linearity and superposition, source transformation,
- Circuit theorems, power calculations, dependent sources,
- Circuit analysis with dependent sources, the operational amplifier,
- Basic op-amp configurations, ideal op-amp circuit analysis, summing and difference amplifiers, amplifier types, capacitance, inductance, natural response of RC and RL circuits,
- Response to DC forcing function, transient response of first order circuits, step,
- Pulse and pulse train responses, first order op-amp circuits,
- Transient response and step response of second order circuits.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:


Electrical Network Analysis

Course Outline

- Current and voltage transients,
- RLC circuits with AC excitation,
- Resonant circuit: series and parallel resonance in AC circuit, Q-Factor, mutual inductance and transformers,
- Introduction to phasor representation of alternating voltage and current,
- Single-phase circuit analysis, star-delta transformation for DC and AC circuits,
- Poly-phase generators, phase sequence,
- Vector diagrams for balance and unbalanced three phase networks,
- Power in three phase circuits and different methods of its measurements,
- Two-port networks and their interconnections,
- Application of Laplace transform in circuit analysis.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

Digital Logic Design

Course Outline

- Number Systems, Boolean Algebra,
- Logic Gates (AND, OR, NOT etc.),
- Karnaugh Maps, QM Method, Combinational circuits,
- Half & Full Adder and Subtractor,
- Comparator, Encoders, Decoders, Multiplexer, De-multiplexer,
- Sequential Circuits, Flip Flop, (RS, JK, D, T, Master Slave),
- State Transition Diagram, Counters, Registers, Memories, PLAs,
- Programmable Logic Devices (PLDs).

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

Electromagnetic Theory

Course Outline

- Review of Vector Analysis, Orthogonal Coordinate Systems,
- Vector Calculus, Gradient, Divergence and Curl,
- Theorems: Helmholtz Theorem, Divergence theorem and applications, Stokes theorem and applications, Greens’ Theorem and applications,
- Coulomb’s Law, Gauss Law, Electric Flux Density, Poisson’s Value Problems, Magnetic Fields, Current Density, Biot-Savart Law,
- Vector Magnetic Potential, Magnetic Field Intensity, Boundary Conditions,
- Maxwell’s Equations In Integral and Point Form, Poynting Vector, Plane Wave,
- Propagation in Isotropic Media, and Simulation using standard tools.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

Electronic Devices & Circuits

Course Outline

- Forward & Reverse Characteristics of Diode, Special Purpose Diodes, Equivalent Circuit of a Diode, Diode as a Switch, Diode Applications,
- Half Wave & Full wave rectifiers, Clipper & Clamper circuits,
- Bipolar Junction Transistor, Transistor Operation, Types of Transistor, Transistor Biasing Configurations,
- Common Emitter, Common Base, Common Collector,
- DC & AC analysis of BJT, Field Effect Transistors, FET Biasing Techniques,
- Common Drain, Common Source, Common Gate,
- Fixed Bias and Self Bias Configuration, Voltage Divider Biasing,
- Universal JFET Bias Curve, DC & AC analysis of FETs.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

Communication Systems

Course Outline

- Introduction to Communication Model, Essential BW of signal, Shannon’s equation,
- Distortion and equalization (With a brief introduction of Fourier analysis, convolution and correlation concepts if required), linear modulation (AM and its types),
- Exponential Modulation, Demodulation and detection techniques,
- Transmission BW for AM & FM signals,
- Pre-emphasis and de-emphasis circuits,
- Pulse Modulation and Demodulation,
- Fundamentals concepts of probability and random processes,
- Noise and its treatment, SNR of AM and FM.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

Signals and Systems

Course Outline

- Complex number and their applications,
- Introduction to continuous-time and discrete-time signals and systems,
- Linear time invariant (LTI) systems,
- Difference equation, causality, BIBO stability, convolution and correlation,
- Fourier series and transforms, time and frequency characterization of signals and systems,
- The sampling theorem, aliasing, z-transform and introduction to discrete Fourier transform.
- Case studies: communication systems, linear feedback systems and analog filter.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

Major Based Core (Breadth)

Digital Communications

Course Outline

- Digital modulation techniques, Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), and Phase Shift Keying (PSK),
- Differential encoding and M-ary signaling, performance of M-ary Signaling, pulse shapes, matched filters, eye diagram,
- Performance (BER and bps/Hz) comparisons of modulation schemes in band limited and non-band limited channels,
- Forward error correction codes,
- Basic concepts of information theory,
- Cellular systems, diversity and multiple access techniques.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

Microprocessors and Microcontrollers

Course Outline

- Introduction to microprocessors, instruction set architecture (ISA),
- Assembly language programming, hardware model, read/write cycles, exception/interrupt processing,
- Memory systems, I/O devices, DMA, interfacing to memory and I/O devices, analog-to-digital and digital-to-analog converters,
- Introduction to microcontrollers, Application, Basic Core Architecture, and Pin Configuration,
- Microcontroller instruction set and programming, Handling of Timers, Counter and Interrupts, Serial Communication, RS-232 protocol, Interfacing of devices including ADC 0804 & ADC 0808, DAC, Keypad interfacing, Stepper motor and LCD, Introduction to PIC microcontrollers.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:


Digital Signal Processing

Course Outline

- Discrete-time signal and its representation, Discrete-time signals and systems, Time-domain analysis of discrete-time signals,
- Frequency-domain analysis, Discrete-time Fourier series, Discrete-time Fourier transform, System response and frequency response,
- Z-transform and its properties, Solution of difference equations using Z-Transform,
- DFT and FFT algorithms,
- Implementation of Discrete-Time systems, Digital filter design, FIR and IIR filters.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

Curriculum of Telecom Engineering / Electrical Engineering (Telecom)


Control Systems

Course Outline

- Classification of open and closed loop control, advantages and disadvantages,
- Effects of feedback, examples including servomechanism, system model and characterization,
- Block diagrams and canonical form, examples of control systems from telecom applications such as satellite tracking, LNAV/VNAV in aviation,
- Flight control systems, heading tracking, signal flow graphs, DE and Laplace transforms, transfer function, poles and zeros,
- Time domain analysis, steady-state error using static error coefficient method, dynamic error constant method, feedback characteristics of control systems, sensitivity of control systems, basic action of controllers (Proportional, Integral, PI and PID controllers),
- Stability assessment (Routh, Bode, Nyquist, Nichols chart),
- Compensation and compensator design for telecommunications applications and state space.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

Antennas and Wave Propagation

Course Outline

- Radiation fundamentals and antenna parameters – radiated power, radiation resistance, radiation efficiency, input impedance, radiation pattern, directivity and gain, linear antennas,
- Matching and feeding networks, antenna arrays, aperture antennas, microstrip antennas, broadband antennas,
- Antennas in wireless technology,
- Properties of receiving antennas – reciprocity, effective antenna area and radar cross section, radio wave propagation,
- Effects of ground and atmosphere on propagation.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

Major Based Core (Depth)

Computer Communication Networks

Course Outline

- What Is the Internet? The network edge, the network core, delay, loss, and throughput in packet-switched networks,
- Protocol layers and their service models, networks under attack,
- History of computer networking and the Internet,
- Principles of network applications, the web and HTTP, FTP, transport-layer services, UDP,
- Principles of reliable data transfer, TCP, network layer, Internet Protocol (IP), link layer services, error-detection and correction techniques,
- Wireless and mobile networks, wireless links and network characteristics, Wi-Fi: 802.11 wireless LANs, cellular Internet access,
- Multimedia networking applications, streaming stored audio and video, making the best of the best-effort service,
- Protocols for real-time interactive applications,
- Providing multiple classes of service and providing Quality of Service guarantees.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

Wireless and Mobile Communications

Course Outline

- Cellular Systems, Interference Geometry, Reuse Factor,
- Trunking Theory, Cell Sectoring, Hand-offs, Multipath-fading, Fading Characteristics, Fading distributions,
- Coherence Bandwidth, Level Crossing Rate, Coherence Time, Coherence Bandwidth, Doppler Spectrum, Broadband Channel Models,
- Multiple Access Techniques, TDMA/FDMA, CDMA,
- Introduction to Digital Modulations, Geometry of Signals, Matched Filtering, Correlation Receivers,
- Linear Modulation Techniques,
- Power Spectrum Analysis,
- Multi-carrier Modulation Techniques, OFDM, Sub-Channel allocations in OFDM,
- Introduction to 4G/LTE, Uplink SD-FDMA.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:


Transmission and Switching Systems

Course Outline

- Digital Telephone Network basics, PSTN, PLMN, dB in Communications, Power Levels, digital over analog transmission,
Curriculum of Telecom Engineering / Electrical Engineering (Telecom)

- Principle of speech digitization, Voice Compression and Transmission, Asynchronous/Synchronous Transmission, Line Coding, Error Coding, Time Division Multiplexing, Space Division Multiplexing,
- Statistical Time Division Multiplexing, PDH and SDH multiplexing hierarchies, exchange hierarchy, PBX, Blocking Probabilities, 4-wire switching, Switch Matrix Control,
- Time and Space Division Switching, Two-dimensional Switching, Toll Switch, Digital Cross Connect & Digital Switching, types of switching,
- Basic functions of typical digital switching exchanges software structure of SPC digital switches,
- Line Codes for Fiber Optic Transmission, routing techniques, software life cycle, Channel SS7 signaling components, intelligent Networks Associated Signaling (CAS) and Common Channel Signaling (CCS) ITU’s Common Channel Signaling System #7 (CCS7 Or SS7),
- Broadband implementation in commercial exchange and introduction to soft switches.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

Microwave Engineering

Course Outline

- Review of Maxwell’s equations, field in media and boundary conditions, the plane wave, reflection from media (dielectric, conductor) boundary, loss in conductors, surface resistance,
- Energy, power, transmission line theory, the lossless line, terminated line,
- Smith’s chart, quarter wave transformer, lossy transmission line, general solution of waveguides, TEM TE and TM modes, TE and TM solution in rectangular waveguide, TEM modes on coaxial line and Strip-line structure, Quasi-TEM on Micro-strip line,
- Characteristic impedance and loss calculations,
- Microwave network analysis, impedance and equivalent voltage and current, impedance matrix, the scattering matrix, signal flow graphs, microwave matching networks, lumped single stub and double stub matching, microwave resonators,
- Properties of series and parallel resonator, transmission line resonator, waveguide resonator, dielectric resonator, resonator coupling, microwave power dividers and couplers,
- Properties of three port and four ports networks,
- Wilkinson’s power divider, hybrid coupler quadrature, coupled line coupler and
- Introduction to microwave active devices.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Book:

Emerging Wireless Technologies and RF Planning

Course Outline

- Channel structure, signal flow, operation and maintenance features vis-à-vis cellular and WLAN/WMAN/ WPAN technologies,
- Wireless network planning process,
- RF environment introduction and propagation model, antenna and feeder system, link budget,
- Capacity theory, site survey, network optimization process,
- Signalling trace, access optimization, handoff optimization, power control optimization, drop call optimization, drive test,
- Introduction to advanced tools for network planning, simulation and optimization

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

Machine Learning for Communications

Course Outline

- Data understanding, data preparation,
- Principles of modeling, multiple linear regression, logistic regression,
- Decision trees and random forests, clustering, classification, decision-making Traps,
- Fundamentals of numerical optimization, special use cases for machine learning application for communications, that may include machine learning for physical layer design, adaptive modulation and coding (AMC): classical AMC, using support vector machines, using k-nearest neighbours, k-means and reinforcement learning,
- Various aspects of communication systems, wireless system design, where machine learning can be applicable in various OSI layers of a communication system and how real time schedulers can benefit from advanced machine learning techniques,
- Design of weiner filters and regression techniques in ML, filtering techniques such as FIR, IIR and the deep neural network architectures such as CNN, RNN,
- Use of principal component analysis in massive mimo system design, auto encoders in wireless communication transceiver design, etc.,
- Connections between hidden markov model (commonly used for NLP) and viterbi algorithm commonly used in convolutional decoders in wireless systems
- Machine learning for optical network design, user grouping/clustering in device-to-device and heterogeneous networks for offloading and interference management,
- Traffic prediction and clustering of small cells,
- Channel State Information Prediction for 5G Wireless Communications using deep learning,
- Deep Reinforcement Learning for Dynamic Multi-channel Access in wireless networks
- Projects based on Kaggle assignments based on application of ML and DL on wireless communications based network data
Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

Optical Fiber Communications

Course Outline

- Introduction to optical fiber communications, basic principles, Snells law,
- Numerical aperture, Fresnel loss, fiber types, single mode and multimode, optical fiber losses, (attenuation, dispersion, polarization),
- Special optical fibers, light sources (LED, LASER), light detection (p-i-n and APD), components and connectors, link budget calculations (power based and rise time based),
- Receiver design considerations (IM/DD and Coherent systems), modulation schemes, receiver performance (BER and Eye Diagram) optical measurement (e.g., OTDR) optical DWDM systems,
- Examples from commercial implementations, e.g., TAT-9, TAT-14, optical amplifiers, EPON, GPON and introduction to FSO.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.
Suggested Books:


Engineering Depth Courses

Multimedia Systems

Course Outline

- Multimedia systems, multimedia networks and applications, networking terminology,
- Digitizing principles, text, image audio, video information representation,
- Text and image compression techniques (JPEG, MPEG)
- Audio and video compression standards for multimedia communication,
- Construction of 3-D images and videos,
- Transport of high definition video signals and VoD.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.
Suggested Books:


**Satellite Communications**

**Course Outline**

- Principles of satellite communication, uplink and downlink frequencies,
- Types of satellites, orbital mechanics,
- Introduction, Kepler’s laws, orbital elements, perturbations and antennas, polarization, the space segment, power supply, altitude control, station keeping, thermal control, TT&C subsystem, transponders, antenna subsystem,
- The earth segment, receive-only home TV systems, transmit/receive earth stations, the space links, equivalent isotropic radiated power, transmission losses, link power budget equation, system noise, carrier-to-noise ratio,
- Interference between satellite circuits, combined (C/I) due to interference on uplink and downlink, antenna gain function, pass band interference, multiple access techniques,
- Direct broadcast satellite (DBS) services, MSAT, VSATs, and GPS.

**Teaching Methodology (Proposed as applicable):**

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

**Assessment:**

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.
Suggested Books:


Telecom Standards & Regulations

Course Outline

- Introduction to ICT Basic Concepts and Selected Regulatory Terminologies,
- Pakistan Telecom Background/Historical Perspective,
- Introduction to and Functioning of Telecom Regulatory Stakeholders in Pakistan,
- Telecom Deregulation and Liberalization, Regulating for Effective Competition,
- Process of legislation in Pakistan and Introduction to Telecom Policies, Act, Rules and Regulations,
- Introduction to / Familiarization with International/ Regional Telecom Organizations / Bodies,
- Introduction to Telecom Standards and Protocols.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:


Telecom Traffic Engineering

Course Outline

- Poisson process, Markov processes, birth-death processes, purpose of tele traffic theory, tele traffic models, classical model for telephone traffic, classical model for data traffic,
- Telecommunication networks, network level - switching and routing, link level - multiplexing and concentration, shared media - multiple access, circuit switched network modeled as a loss network, packet switched network modeled as a queuing network,
- Traffic measurements, traffic variations, traditional modeling of telephone traffic, traditional modeling of data traffic, simple tele traffic model, Poisson model, Erlang model, binomial models, Engset model M/M/1, M/M/n, generation of traffic process realizations,
- Generation of random variable realizations, collection of data, statistical analysis,
- Network planning, traffic forecasts, dimensioning, MPLS traffic management, IP-networks,
- Traffic and congestion control in the Internet and QoS architectures in the Internet.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.
Curriculum of Telecom Engineering / Electrical Engineering (Telecom)

Suggested Books:


Next Generation Networks

Course Outline

- NGN standardization by ITU, fixed and mobile broadband as basis for NGN, NGN architectures, NGN services, QoS and IMS for NGN deployments, VoIP and IPTV services over NGN, Internet of Everything, VPN in NGN, IPv6-based NGN, migration scenarios from legacy networks to NGN,
- Business approaches and regulation for NGN, future networks as defined by ITU, including network virtualization, software defined networking, smart ubiquitous networks, big data issues,
- OTT service providers versus Telco service models, impact of M2M in the future, convergence of regulation towards future networks, cloud computing, including ITU's framework,
- Cloud ecosystem, architectures and cloud service models, cloud security, OTT cloud services, Telco cloud implementations,
- Mobile cloud computing services and applications, as well as business and regulation aspects for cloud computing.
Teaching Methodology (Proposed as applicable):
Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:
Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

Network Security

Course Outline
- Web security, security standards, intruders and viruses, firewalls,
- Shannon’s theory of perfect secrecy, shift and product cipher, Vernon’s one-time pad;
- Secret key and public/private key cryptography, cryptographic hashes and message digests, authentication systems (Kerberos),
- Digital signatures and certificates, Kerberos and X.509v3 digital certificates, PGP and S/MIME for electronic mail security,
- Current network security publications and web sites.
Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:


Radar Systems Engineering

Course Outline

- Operation, range equation, frequencies, parameters and prediction of range performance,
- Minimum detectable signal, receiver, signal to noise ratio,
- Integration of radar pulses, radar cross section, transmitter power,
- Antenna parameters, system losses, propagation effects, radar clutters, CW and frequency modulated radar, MTI and pulse Doppler radar, tracking radar, radar transmitters, antennas, receivers, displays and duplexers, detection criteria, detector characteristics,
- Performance of radar operator, automatic detection, atmospheric echoes and detection of target in clutter.
Teaching Methodology (Proposed as applicable):
Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:
Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

Telecommunication Network Management
Course Outline
- TNM architecture, functional architecture,
- Physical architecture and information, logical layered architecture,
- TNM relationship with other management approaches, requirements, analysis, and class diagrams, alarm management information object classes,
- Inheritance and relationship between alarm list and information,
• IRP operations, generic rules, TNM design, eTOM, NGOSS, ITIL, managing next generation networks, ITU-T M.3100 information model, G.803, CMIP, F-interface architecture, SNMP,
• Packet types and fundamentals of RF planning.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:


Multidisciplinary Engineering Courses

Numerical Methods in Engineering

Course Outline

• Floating point number system, error analysis, solutions of equations, interpolation, splines,
• Numerical differentiation and integration, numerical methods in linear algebra,
• System of linear equations, method of least squares, eigenvalues, eigenvectors,
• Solution of ordinary and partial differential equations.
Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Book:


Operating Systems

Course Outline

- Overview of computer system and operating system,
- Process description and control, process scheduling, threads, symmetric multiprocessing, mutual exclusion and critical section, lost update problem, busy waiting versus blocking,
- Peterson’s algorithm, interrupt disabling and spin lock, semaphore, partitioning, paging and segmentation, virtual memory,
- Address translation and page fault handling, page table and translation look aside buffer, memory management algorithms,
- Fetch policy, replacement policy, resident set management, I/O devices, organization of I/O function, I/O buffering, disk scheduling, RAID,
- Organization of files and directories, secondary storage management, file systems, and modern operating systems.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.
Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:


VLSI Systems

Course Outline

- MOS device models including Deep Sub-Micron effects, circuit design styles for logic, arithmetic and sequential blocks,
- Estimation and minimization of energy consumption,
- Interconnect models and parasitics, device sizing and logical effort, timing issues (clock skew and jitter) and active clock distribution techniques,
- Memory architectures, circuits (sense amplifiers) and devices and testing of integrated circuits.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.
Suggested Book:


Data Structures and Algorithms

Course Outline

- Fundamental data structures, data types, abstract data types, user defined data types,
- Algorithms and their complexity, time-space trade off, arrays, records and pointers, matrices, linked lists, circular lists, two way lists,
- Sequential (array) and linked implementation of stacks and queues, polish notation, recursion, towers of Hanoi,
- Recursive implementation of stacks and queues, priority queues, tree, binary tree, binary search tree, traversals, threaded trees, heap, general trees, graphs, depth-first/breadth first traversal, adjacency matrix,
- Shortest distance algorithms, sorting, insertion sort, selection sort, merge sort, radix sort), hashing, searching: (linear search, binary search, depth first / breadth first search.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

Embedded Systems

Course Outline

- Introduction to Embedded Systems, Hardware Architecture of Embedded Systems,
- Programming Model of Embedded Systems,
- I/O Port structure and Memory Organization,
- Serial and Parallel Interface,
- Timers and Interrupt Handling,
- Software Design for Embedded Systems, Single Board Computer,
- Software Development Tools,
- Hardware Interfacing and Introduction to AVR Microcontrollers.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

Reliability in Telecommunication Systems

Course Outline

- Introduction, basic reliability concepts, kinds of failure,
- The reliability function, catastrophic-failure models, combinational reliability, system reliability,
- Effects of repair, mathematical design,
- Statement of design problem in mathematical terms,
- Yield and drift reliability,
- Methods for computing probability of system success and optimization techniques

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:


Occupational Health and Safety

Course Description:

This course introduces the student to the study of workplace occupational health and safety. The student will learn safe work practices in offices, industry and construction as well as how to identify and prevent or correct problems associated with occupational safety and health in these locations as well as in the home.

Learning Outcomes:

Upon successful completion of this course, the student will be able to:
• Identify hazards in the home, laboratory and workplace that pose a danger or threat to their safety or health, or that of others.
• Control unsafe or unhealthy hazards and propose methods to eliminate the hazard.
• Present a coherent analysis of a potential safety or health hazard both verbally and in writing, citing the Ontario Occupational Health and Safety Regulations as well as supported legislation.
• Demonstrate a comprehension of the changes created by WHMIS and OSHA legislation in everyday life.

Course Outline:

Health and Safety Foundations
• Nature and scope of health and safety
• Reasons/benefits and barriers for good practices of health and safety
• Legal framework and OHS Management System

Fostering a Safety Culture
• Four principles of safety- RAMP (Recognize, Assess, Minimize, Prepare)
• Re-thinking safety-learning from incidents
• Safety ethics and rules
• Roles and responsibilities towards safety
• Building positive attitude towards safety
• Safety cultures in academic institutions

Recognizing and Communicating Hazards
• Hazards and Risk
• Types of hazards: Physical (mechanical and non-mechanical), Chemical (Toxic and biological agents), electrical, fire, construction, heat and temperature, noise and vibration, falling and lifting etc.
• Learning the language of safety: Signs, symbols and labels

Finding Hazard Information
• Material safety data sheets
• Safety data sheets and the GHS (Globally Harmonized Systems)
Accidents & Their Effect on Industry

- Costs of accidents
- Time lost
- Work injuries, parts of body injured on the jobs
- Chemical burn Injuries
- Construction injuries
- Fire injuries

Assessing and Minimizing the Risks from Hazards

- Risk Concept and Terminology
- Risk assessment procedure
- Risk Metric’s
- Risk Estimation and Acceptability Criteria
- Principles of risk prevention
- Selection and implementation of appropriate Risk controls
- Hierarchy of controls

Preparing for Emergency Response Procedures

- Fire
- Chemical Spill
- First Aid
- Safety Drills / Trainings:
  - Firefighting
  - Evacuation in case of emergency

Stress and Safety at Work Environment

- Workplace stress and sources
- Human reaction to workplace stress
- Measurement of workplace stress
- Shift work, stress and safety
- Improving safety by reducing stress
- Stress in safety managers
- Stress and workers compensation
Incident Investigation

- Importance of investigation
- Recording and reporting
- Techniques of investigation
- Monitoring
- Review
- Auditing Health and Safety

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Mid-semester exam, report writing/presentation, assignment, project report, quizzes, end-semester exam

Suggested Books:


12.2 Non-Engineering Domain

**English Courses**

**Functional English**

**Area Scope:**
The knowledge units in this area collectively encompass the following:

- Follow English vocabulary and skills to use it in professional life.
- Identify common errors usually made by the Learners of English as second language
- Practice English correctly in speaking and writing

**Course Outlines:**

- Public Speaking
- The Art of Creating a Power Point Presentation.
- Interacting with the Opposite Gender
- Classroom Etiquettes and Teachers’ Expectations
- Articles
- Prepositions
- Homophones
- Punctuation
- Tenses in English Grammar
- Formal Letter Writing
- Summary writing
- Organizing and planning your writing
- Sensory Perception in writing.
- Critical thinking
- Final Term Project

**Teaching Methodology (Proposed as applicable):**

Lectures (audio/video aids), Written Assignments/Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/Field Visits, Group discussion, Report Writing
Curriculum of Telecom Engineering / Electrical Engineering (Telecom)

Assessment:
Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:
- P. C. Wren & H. Martin “High School English Grammar & Composition”.
- Colin W. Davis & Andrew J. Watts New Expressway For English 1 (New Edition)
- Herta A. Murphy & Herbert William Hildebrandt. Effective Business Communications
- Diana Hacker. A Writer’s Reference

Communication Skills

Area Scope:
The knowledge units in this area collectively encompass the following:
- Communicate effectively using intermediate- to-advanced level English while developing the understanding of essentials of communication skills.
- Participate in group discussions by attentive listening, questioning to clarify ideas, eliciting responses, or disagreeing in a constructive way.

Course Outlines:
By the end of the semester students will have skills including:

Writing Skills
- Vocabulary Building
- Writing Skills: Essays and Letters
- Common Writing Errors
- Purposeful Writing

Reading Skills
- Skimming and Scanning
Critical Reading
Reading for Understanding
Techniques and strategies to develop sound vocabulary.

Listening Skills
- Introduction to Communication Process
- Seven Cs of Communication
- Types of Listening
- Listening for Comprehension

Speaking Skills
- Verbal and Non-Verbal Communication
- Basics of Presentation Skills
- Presentation Strategies and public speaking skills.
- Use of Audio-Visual Aids
- Basics of Group Communication
- Listening Skills
- Communicate effectively in job interviews.

Teaching Methodology (Proposed as applicable):
Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:
Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:
- Anchor in English-II (Lessons 1-5), A SPELT Publication
- Christopher Fry, “Summary Writing (Book-I)”, Oxford University Press
- College Essays by John Langland
- Barron’s TOFFL iBT Edition
- Communication Skills for Engineers by Sunita Marshal and C. Muralikrishna
Technical Writing and Presentation Skills

Area Scope:
The knowledge units in this area collectively encompass the following:

- The students will be able to write technically correct statements, assignments, final year project report, project proposal, short report and research paper
- The students would be able to write CV, cover letter and business/professional Correspondence meeting all criteria
- The students would be able to present their work/research at a technical forum.

Course Outlines:

- Introduction to Technical writing
- Proposal write-up and improvement strategies
- Introduction to research and research types choosing research problems and research advisors
- How to carry out research
- Formulation – Problem statement, Literature
- Review
- Design - Methodology
- Analysis - Data analysis and interpretation
- Good writing style techniques
- Uses of correct words
- Presenting and publishing research
- Write business/professional correspondence, cover letter and CV
- Writing meeting minutes

Teaching Methodology (Proposed as applicable):
Lectures (audio/video aids), Written Assignments/Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/Field Visits, Group discussion, Report Writing

Assessment:
Mid Term, Report writing/Presentation, Assignments, Project Report, Quizzes, Final Term
Suggested Books:

- Writing for Computer science by Justin Zobel Research Methodologies – A step by step guide for beginners, Ranjit Kumar.

Mathematics Courses

Linear Algebra

Area Scope:

The knowledge units in this area collectively encompass the following:

- To comprehend basic concepts of Linear Algebra and optimization
- To apply techniques of Linear Algebra and optimization for solution of engineering problems

Course Outline:

System of Linear Equations and Applications

- Overview of linear system of equations, Cases of unique solution, No solution and infinite solutions,
- Echelon form, Gauss elimination method, Inversion of matrix in the context of solution of system of equations, LU factorization, Row space and column space
- Relevant engineering case studies such as Network analysis, Traffic Flows, Balancing chemical reaction, Leontief Input-output model, Finding max stress in compound cylinder, Applications of linear systems in force balancing of structures, Markov process

Vector Spaces and Transformations

- Vector Spaces: Real vector spaces, Subspaces, Basis and dimension, Rank, Nullity
- Gram-Schmidt process for finding orthonormal basis
- Linear Transformation, Kernel of Transformation, Range of Transformation, Matrix of Transformation,
- Applications: Cryptography, Coding and decoding, Breaking of codes, Robotic Applications of linear transformations
Eigenvalues and Eigen Vectors

- Eigenvalues, Eigenvectors, Similar matrices, Diagonalization,
- Quadratic forms, Positive definite Matrices, Singular Value Decomposition, Inner product Spaces
- Applications of linear Algebra: Constructing curves and surfaces, Computer graphics, Genetics

Linear Programming

- Solution Introduction to linear programming, Optimization, Graphical method, Simplex method, Optimization problems in engineering and economics
- Dual simplex methods, Duality theory, Primal and dual problems, transportation models, north-west corner, least-cost and Vogel’s approximations methods,
- Assignment model, the transshipment model and other relevant engineering case studies

Application of Linear Algebra in Dynamical Systems

- Numerical System of linear ODEs, Eigenvalue problems, Homogeneous and nonhomogeneous system of ODE.
- Dynamical systems, Population dynamics, Prey-Predator models, Stability analysis

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

Calculus and Analytical Geometry

Area Scope:

- To develop a clear understanding of fundamental concepts of single variable calculus
- To apply concepts of differentiation and integration to solve complex engineering problems

Course Outline:

Analytical Geometry:

- Review of vectors, scalars and vector products.
- Three dimensional coordinate system and equation of straight line and plane

Functions Limit and Continuity:

- Review of functions and graphs,
- Limits & Continuity,
- Techniques of Finding Limits,
- Discontinuity,
- Limits of Sine and Cosine and Exponential Functions

Differentiation:

- Introduction to Derivatives
- Examples of Derivatives
- Derivative as Rate of Change
- Derivative’s Rules
- Implicit Differentiation
- Higher order derivatives
- Leibnitz Theorem

Applications of Derivatives:

- Applications of Derivatives
- Monotonic functions
- Optimization problems
- Relative and Absolute extrema
- First and second derivative tests
• Point of inflection
• Concavity
• Curvature
• Indeterminate Forms and L’ Hospital rule
• Differentials

Integration:

• Integrals and Properties of Integrals
• Techniques of Integration
• Integration by Parts
• Definite Integrals
• Integration of Trigonometric
• Exponential and Inverse Functions
• Integration by Partial Fractions
• Reduction Rules

Applications of Integration:

• Applications of Integration
• Area under the curve
• Area between curves
• Solids of Revolution
• Volume of Solids of revolution by disk
• Washer, Cylindrical shell & Cross Section Methods
• Center of Pressure and Depth of Center of Pressure
• Center of mass
• Arc length

Improper Integrals:

• Improper Integral
• Integrals and Singularities
• Convergence of improper integrals

Infinite Sequence and Series:

• Sequence and Infinite Series
• Convergence and Divergence of sequences and series
• Positive Term Series
• Integral Test
• Basic Comparison Test
• Limit Comparison Test
• Ratio and Root tests
• Alternating series
• Absolute and Conditional Convergence

**Power and Taylor Series:**

• Power series
• Maclaurin and Taylor Series and its Applications

**Teaching Methodology (Proposed as applicable):**

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

**Assessment:**

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

**Suggested Books:**

• Thomas' Calculus by George B. Thomas, Jr., Maurice D. Weir, Joel R. Hass, Pearson, USA.
• Swokowski, Onlinick & Pence: Calculus
• Robert T. Smith & Roland B. Minton: Calculus
• Calculus: Early Transcendentals by James Stewart. Brooks/Cole USA.

**Differential Equations**

**Area Scope:**

The knowledge units in this area collectively encompass the following:

• To define basic mathematical concepts related to differential equations
• To describe different types of analytical methods for solution of differential equations
To formulate different engineering problems in the form of differential equations

Course Outline:

Basic Concepts and Modeling

- Linear Differential equations, Non-Linear, Differential equations, Solutions of differential equations, General solutions, Particular solutions, Initial and boundary value problems, Degree and order of ODEs
- Formulation of first-order ODEs: Case studies related to finding age of fossils, Mixing problems and free fall motion, finding temperature of a building, RL, RC circuits, Airplane take-off problem, Population dynamics and logistic equations etc.

Analytical Methods of Solution for First-order ODEs

- Variable separable method, Reduction to variable separable form, Homogeneous equations, Differential equations reducible to homogeneous form, Solution of the related ODE models by these methods
- Exact equations, Integrating factors, Linear equations and related examples, Bernoulli’s equations, Orthogonal trajectories and solution of the related ODE models by these methods

Mathematical Models Based on Second-order ODEs

- Formulation of a single RLC circuit, Spring mass systems, Earthquake model of a single story building
- Bungee Jumper model, Bridge collapse problem etc.

Analytical Methods of Solution for Second-order ODEs

- Homogeneous linear ODEs, Method of reduction order, Wronskain determinant to check independence of the solution, and related examples
- Cauchy-Euler equations and related examples, Non-homogeneous linear ODEs, Method of undetermined coefficients
- Method of variation of parameters and related example
- Analytical solution of the related ODE models by these methods
Series Solution for Second-order ODEs

- Series solution of ODEs and convergence tests
- Series solution of Legendre equation, Frobenious method of solution for Bessel equation and related applications

Laplace Transform

- Laplace Transform, Derivation of Basic formulae, Inverse Laplace Transform, First shift theorem
- Laplace transform of integrals and derivative, Solution of second order ODEs by Laplace Transform, Unit step function and its Laplace transform, Second shift theorem, Convolution
- Application of Laplace transform to a system of ODEs and related applications

Partial Differential Equations

- Partial Differential Equations and their types, Applications of partial differential equations in Engineering
- Method of Separation of Variables Method (MSVM) and solution of wave equation by the MSVM
- Method of Separation of Variables Method (MSVM) and solution of heat equation by the MSVM

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:


Numerical Analysis

Area Scope:
The knowledge units in this area collectively encompass the following:

• To comprehend different numerical techniques such as: error propagation, interpolation, differentiation, integration, eigenvalues and solution of algebraic and differential equations
• To apply the numerical techniques to different linear and nonlinear engineering problems

Course Outline

Error Analysis and Interpolation

• Error analysis, Types of error, Sources of error, Norms of vectors and matrices, Computer arithmetic, Condition number of a matrix, Significant digits and loss of significant digits, Floating point arithmetic, Binary and decimal representation, Single and double precision
• Interpolation: Newton forward and backward difference formula for interpolation, Central difference interpolation formulae, Lagrange’s interpolation, Error in interpolation, Linear least square approximation, Interpolation versus least square approximation, relevant engineering case studies

Numerical Differentiation and Integration

• Derivation of numerical differentiation of first order and second order derivatives using two points, three points, and five points formulas along with its application in engineering, Relevant case studies
• Numerical integration: Trapezoidal rule, Simpson’s rules, Composite Trapezoidal Simpson Rules and Romberg integration, Applications of numerical in engineering, Relevant case studies
Methods of Solution a System of Linear Equations

- Solution of system of linear algebraic equations, Gauss elimination method
- LU factorization, Tridiagonal solver
- Applications of these methods in engineering disciplines, relevant case studies

Iterative Methods for Linear and Nonlinear Equations

- Numerical Solution of nonlinear equations: Bisection method, Newton’s method, Secant method, Convergence analysis of these methods
- Newton’s method for system of nonlinear equations
- Solution of system of linear equations by Jacobi, Gauss Seidel and SOR methods, Applications of these methods in engineering disciplines, relevant case studies

Numerical Methods for IVPs and BVPs

- Euler’s method and its variations, Taylor’s higher order methods, Error analysis, Consistency, stability and convergence
- Runge-Kutta methods of order 2, 3, and 4, Stiff ODEs, Consistency, stability and convergence
- Linear multistep methods, Numerical solution of system of ODEs
- Numerical solution of BVPs by Finite Difference Method
- Applications in engineering: Some relevant case studies

Numerical Methods for Computing Eigenvalues

- Eigenvalues and Eigenvectors of matrix: power method,
- Inverse power method, Shifted inverse power method.
- Applications of eigenvalues in engineering disciplines.

Numerical Optimization

- Unconstrained Optimization,
- Golden search ratio, Lagrange Multipliers,
- Method of steepest descent
- Applications of optimization in engineering disciplines
Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:


Probability & Statistics

Area Scope:

The knowledge units in this area collectively encompass the following:

- To understand the basic concept of Statistics and Probability and their need in engineering.
- To describe properties and classifications of probability density functions, regression analysis and interval estimation
- To apply different probability and statistics techniques in engineering problems

Course Outline

Basic Statistics

- Statistics, Branches of Statistics, Importance of statistics, population, sample, observation, variables, measurement of variable, Data, primary data, secondary data
Data Presentation

- Frequency distribution (grouped, ungrouped), stem and leaf display, histogram, frequency polygon, cumulative frequency polygon, Simple & Multiple Bar diagrams

Measure of Central Tendency

- Arithmetic Mean (A.M), Geometric Mean (G.M), Harmonic Mean (H.M), Quantiles (Median, Quartiles, Deciles, Percentiles), Mode, Applications of Averages

Measure of Dispersion

- Background, Range, Quartile deviation, Mean deviation, Variance, Standard deviation, Coefficient of variation, Moments, Moments ratios, Skewness, Kurtosis
- Applications in different Engineering Disciplines

Simple Regression, Correlation and Curve Fitting

- Introduction to regression theory, Simple linear regression line, Line fitting by least square methods, Coefficient of determination,
- Simple correlation, coefficient of correlation, fitting of a first and second degree curve, fitting of exponential and logarithmic Curves, related problems.
- Principle of least squares.

Probability and Random Variables

- Probability review, Laws of probability, Conditional probability, Bayesian theorem, independent, dependent events.
- Random variables, Discrete and Continuous random variables, Probability mass and density functions, Distribution functions, Mathematical expectation,
- Variance of random variable, Bivariate distribution, Joint probability distribution, Moment generating function
Curriculum of Telecom Engineering / Electrical Engineering (Telecom)

Probability Distributions

- Discrete distributions:
  - Bernoulli distribution, Binomial, Geometric, Negative binomial, Hyper-geometric, Poisson distribution, Properties and application of these distributions.
- Continuous Distributions: Uniform Distribution, Exponential distribution, Normal distribution, Applications

Sampling and Sampling Distributions

- Introduction, Population, Parameter & Statistic, Objects of sampling, Sampling distribution of Mean, Standard errors, Sampling & Non-Sampling Errors,
- Random Sampling, Sampling with & without replacement, Sequential Sampling, Central limit theorem.
- Applications in relevant engineering discipline

Statistical Inference and Testing of Hypothesis

- Introduction to inferential statistics, Estimation, hypothesis testing of population mean, proportion,
- Variance, Applications in Engineering

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Introduction to Statistical theory part 1, by Sher Muhammad Chuadary (Latest Edition)
- Probability and Statistics for Engineers and Scientists, by Antony Hayter.
- Elementary Statistics, by Bluman.
Complex Variables & Transforms

Area Scope:
The knowledge units in this area collectively encompass the following:

- Explain the concept of complex number system, complex function, limit, continuity, differentiability and integral of complex valued functions
- Utilize the theory of complex integration and power series (Taylor series, Laurent series) to solve problems from the area of residue calculus
- Apply various transforms to solve complex integration.

Course Outline

Introduction:

- Review of complex numbers, Complex valued functions, Elementary functions (exponential and logarithmic functions, Trigonometric and hyperbolic functions and theirs inverses),
- Limits and continuity,
- Applications in Engineering

Complex Differentiation and Integration

- Derivatives of complex valued functions, Differentiability,
- Analyticity, Cauchy Riemann Equations, Harmonic Functions,
- Complex integrals, Cauchy-Goursat Theorem, Independence of Path, Cauchy’s Integral Formulas and Their Consequences, Applications

Power Series:

- Taylor Series, Laurent Series, Singularities, Zeros and poles, Residue integration method, Residue theorem,
- Conformal mapping

Laplace Transformation:

- Linearity, Scaling, First shifting theorem, Heaviside’s Shifting theorem,
- Inverse Laplace transformation, Properties of inverse Laplace,
- Convolution theorem, Applications in relevant engineering discipline
Special functions and Fourier Transforms:

- (Gamma, Beta functions, Periodic functions, Error function),
- Fourier Series, Fourier Sine and Cosine series,
- Fourier transform, Fourier cosine and sine transform, properties.
- Applications in relevant engineering discipline

Z-Transformation:

- Z-transform, Properties of Z-transform, linearity and scaling, Standard Z-transform, Inverse Z-transform,
- Inverse Z-transform by using residue, convolution theorem of Z-transform,
- Formation of difference equation and its solution using Z-transform.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Complex Variables and Applications by Churchill, Latest Edition

Multivariate Calculus

Area Scope:

The knowledge units in this area collectively encompass the following:

- To develop a clear understanding of fundamental concepts of multivariable variable calculus
To describe the concept of gradient, multiple integrals in rectangular, polar, cylindrical and spherical coordinates, directional derivatives, and optimization problems

To apply the concepts line integrals, surface integrals, volume integrals, Green's, Stokes', Gauss theorems to different engineering problems

Course Outline:

Geometry of Space:

Analytical Space Geometry, Cylindrical and Spherical coordinates, Lines in space, Intersection of Line and a Plane

Vector-Valued Functions and Motion in Space:

Functions of several variables, their limits and continuity, Quadratic Surfaces, Parametric representation of curves, Velocity and Acceleration, Arc length, Tangent, Normal, Bi-normal, Curvature & Torsion

Partial Differentiation:

Partial derivatives, Total Differentials, Chain Rule with More Variables, Directional derivatives

Applications of Partial Derivatives:

Optimization Problems, Extrema of functions of several variables, Conditional extrema, Lagrange Multipliers and Example

Multiple Integrals

Double Integration, Order of Integration, Double Integrals in Polar Coordinates, Applications: Mass and Average Value, Moment of Inertia, Triple Integrals, Rectangular and Cylindrical Coordinates, Applications and Examples, Triple Integrals in Spherical Coordinates

Vectors in 3 Space:

Introduction to vectors, Scalar and vector product, Volume of parallelepiped and tetrahedron, Gradient of a Scalar Field, Divergence of a Vector Field, Curl of a Vector Field
Integration in Vector Fields:
Line Integral, Integration around Closed Curves. Work Done, Potential and Related Examples, Conservative and non-Conservative Fields, Green’s Theorem, Divergence Theorem, Stoke’s Theorem, Applications of Double and Triple integrals

Teaching Methodology (Proposed as applicable):
Lectures (audio/video aids), Written Assignments/Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/Field Visits, Group discussion, Report Writing

Assessment:
Mid Term, Report writing/Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:
- Thomas' Calculus by George B. Thomas, Jr., Maurice D. Weir, Joel R. Hass. Pearson, USA.
- George B. Thomas, Jr. and Ross L. Finney, Calculus and Analytic Geometry
- Swokowski, Onlinick & Pence: Calculus
- Robert T. Smith & Roland B. Minton: Calculus
- Calculus: Early Transcendental by James Stewart, Brooks/Cole USA

Applied Physics

Course Outline:
Vectors:
Review of vectors, Ordinary Differentiation of Vector, Gradient of Scalar field, Divergence and Curl of Vector Field. Line, surface and volume integrals with their applications.

Electricity & Magnetism:
Electric field due to Discrete and Continuous Charge Distributions, Electrostatic Potential of discrete and Continuous charges, Gauss’s Law and its Applications,
Lorentz Force and Hall Effect, Ampere’s Law, Magnetic Field due to current element (Circular Current Loop and Solenoid), Faraday’s law, and Maxwell’s equations.

**Waves & Oscillations:**


**Optics and Lasers:**


**Atomic and Nuclear Physics:**


**Conduction of Electricity in Solids:**


**Teaching Methodology (Proposed as applicable):**

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

**Assessment:**

Mid-semester exam, report writing/presentation, assignments, project report, quizzes, end-semester exam

**Suggested Books:**

- Hugh D. Young and R.A. Freedman, University Physics. 12th Edition
Social Sciences Courses

Sociology for Engineers

Area Scope:

This course is meant to provide engineering students, with an opportunity to view the discipline of sociology from the engineering perspective and will highlight its application to engineering profession. This will also enable the engineers to fit their technical ideas into a socially acceptable product /project in a more successful manner. The knowledge units in this area collectively encompass the following:

- To introduce to the methods and philosophy of the social science to help their understanding of the socio-cultural dimension of human existence as a fundamental reality in engineering projects etc.
- To provide opportunity for students to begin the process of considering social problems/ issues while designing engineering products.
- To allow engineers to play a pro-active role in critical discussions of social issues specifically.
- To demonstrate comprehension of roles and functions of various social institutions, state organizations, Professional bodies and relationships for analyzing their social impact Assessment.

Course Outline:

Fundamental Concepts and Importance of Sociology for Engineers


Cultural Impacts of Engineering Projects on Society

Definition of Culture, Types of Culture & Elements of Culture, Culture & Power, Authority, Dominance Socialization and Personality, Role of Engineering Projects on Culture, social norms and values of Society, Cultural Infusion of Engineers in Society
Theoretical Perspective of Sociology: Diffusion and Innovation; Adoption and Adaptation; Social development; Community Development

Community Development & Social consequences of Industrialization, Development Processes of Societal Development, Cooperation and Conflict in Community Development in Engineering Context.

Understanding of Societal & Ethical Norms and Values for Engineers

Engineering Ethics, Engineering product/services for less privileged, Role of Engg & Technology in addressing Social inequality, Core Social Values/Norms affecting Engg Performance

Organizational Social Responsibility (OSR) of Engineers

- Extent to which development intends to sensitizes societal and under-privileged needs
- Gender inclusiveness and balance
- Special and Disadvantaged Community of the Area
- Planning for community inclusiveness
- Societal Obligation of Engineers

Engineers, Society and Sustainability

Social System and Concept of Sustainable Development Technology and Development, Population Dynamics in Pakistan, Causes and Consequences of Unplanned Urbanization, Community Development, Programs in Pakistan, Community Organization & Engineering Projects, Population, Technological & Industrial expansion and Development with focus on social/human/ethical dimensions.

Industrial & Organizational Psychology

Interpersonal Relations, Interpersonal Behavior, Formation of Personal Attitudes, Language and Communication, Motivations and Emotions, Impact of Technology on human feelings and level of Sensitivity

Climate Change and Ecological Friendliness from Engineering Perspective

Environment, Social Impact of Technology & Engineering Products & Services (Solid Waste Disposal, Pollution control etc.).

**Social Approaches and Methodologies for Development Administration & Stakeholders Analysis:**

All Phases of the Project (pre, post and execution) Structured, Focused Group, Stakeholder Consultative Dialogues etc. Dynamics of Social Change, Sociology of Change and Industrial Development, Social Change due to Technology Driven Economic Growth.

**SIA (Social Impact Assessment):**


**Engineering Intervention for Social Stratification:**

Factors of Social Stratification, Engineering Interventions for addressing Social Stratification, Social Mobilization through Technological Innovation.

**Case Studies of Different Development Projects in Social Context**

**Teaching Learning Approaches:**

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Project / Field Visits, Group discussion, Community Service, Report Writing, Social Impact Review and Social Audit of Engg Project

**Assessment:**

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

**Suggested Books:**

• Nichols, S.P. and Weldon, W.F. latest edition. Professional Responsibility: The Role of Engineering in Society Center for Electromechanics, The University of Texas at Austin, USA.

**Sociology**

**Area Scope:**

The knowledge units in this area collectively encompass the following:

• To introduce the necessary subject knowledge and understanding required for the successful study of Sociology and related Social Science disciplines at undergraduate.
• To develop skills of application, analysis and evaluation in the context of the study of Social Science.
• To develop a knowledge and understanding of sociology both at a global and national level.
To introduce the planning and organization skills necessary to develop as independent, autonomous learners.

To develop the confidence and competence of the students as learners and to assist them in taking some responsibility for their own learning through directed study and reading.

Course Outline:

- Introduction: Sociological Perspective,
- The Development of Sociology,
- The Role of Values in Sociology, Prejudice In Early Sociology,
- Theoretical Perspective in Sociology. Culture: Components of Symbolic Culture, Subcultures and Counter Cultures, Cultural Universals, Animals and Culture,
- Technology and Global Village, Sociology and New Technology.
- Socialization: Social Development of Self, Mind, and Emotions,
- Socialization into Gender Social Structure and Interaction,
- Social Institutions. Research in Sociology: Research Model, Research Methods. Experiments, Ethics,
- Bureaucracy and Formal Organizations, Rationalization of Society, Formal Organizations and Bureaucracy,
- Voluntary Associations Social Classes, Economy, Politics, Power and Authority, Family, Medicine, Health and Illness, Population and Urbanization, Social Movements
- Social Psychology with special reference to attitudes, attributions and behavior, Emotions, Cognition and Thinking, Reasoning, Problem-Solving and Creativity, Personality, Intelligence, and Abnormal Behavior, etc.
- Introduction to the Field of Organizational Behaviour
- Conflict and Negotiation in the Workplace
- Leadership in Organizational Settings and Organizational Culture
- Ethics: In General an introduction and the development of ethical theory.
- Ethics in Islam, a comprehensive view with different ethics approaches and Ethics Theories
- Research Methods for Society and Sociology
Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:


Engineering Economics

Area Scope:

- Apply the appropriate engineering economics analysis method(s) for problem solving i.e. present worth, annual cost, rate of return, payback, break-even, benefit-cost ratio
- Evaluate the cost effectiveness of individual projects using the methods learnt, draw inferences for investment decisions, and compare the life cycle cost of multiple projects.
- Compute the depreciation of an asset using standard depreciation techniques to assess its impact on present or future value

Course Outline:

Engineering Economics

- Role of engineers in business
- Economic decisions v/s design decisions
- Large scale engineering projects and types of strategic economic decisions
- Fundamental principles of engineering economics

Interest Rate and Economic Equivalence

- Interest: The Cost of Money
- Economic Equivalence
• Development of Formulas for Equivalence Calculation
• Unconventional Equivalence Calculations

Understanding Money and Its Management
• Nominal and Effective Interest Rates
• Equivalence Calculations with Effective Interest Rates and with Continuous Payments
• Changing Interest Rates
• Debt Management
• Investing in Financial Assets

Present-Worth Analysis
• Project Cash Flows
• Initial Project Screening Methods: payback Screening and Discounted Cash Flow Analysis
• Variations of Present-Worth Analysis
• Comparing Mutually Exclusive Alternatives

Annual Equivalent-Worth Analysis
• Annual Equivalent-Worth Criterion
• Capital Costs versus Operating Costs
• Applying Annual-Worth Analysis
• Life-Cycle Cost Analysis
• Design Economics

Rate-of-Return Analysis
• Rate of Return and Methods of Finding It
• Internal Rate-of-Return Criterion
• Mutually Exclusive Alternatives

Cost Concepts Relevant to Decision Making
• General Cost Terms; Classifying Costs for Financial Statements
• Cost Classifications for Predicting Cost Behavior
• Future Costs for Business Decisions
• Estimating Profit from Production
Depreciation and Corporate Taxes

- Asset Depreciation: Economic versus Accounting
- Book and Tax Depreciation Methods (MACRS)
- Depletion
- Income Tax Rate to be used in Economic Analysis
- The Need for cash Flow in Engineering Economic Analysis

Developing Project Cash Flows

- Cost-Benefit Estimation for Engineering Projects
- Developing Cash Flow Statements

Project Risk and Uncertainty

- Origins of Project Risk
- Methods of Describing Project Risk: Sensitivity, Break-Even and Scenario Analysis

Special Topics in Engineering Economics

- Replacement Decisions
- Capital Budgeting Decisions
- Economic Analysis in the Service Sector

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

Social Psychology

Area Scope:
To impart knowledge of social psychology of attraction; attitudes and prejudice; altruism and aggression; personal and social identities; conformity; group influence and their applications in the real world.

Course Outline:
- Principles of sociology and psychology with emphasis on the individual and his/her reciprocal interaction with groups,
- basic psychological factors, attribution and perception of others, attitudes and attitudinal change, social attitudes, altruism, helping others, aggression, hurting others, prejudice, disliking others, discrimination and stereotypes,
- Language and communication, society and cultures, culture and personality, small groups and their relation to the individual, leadership and group dynamics. Attraction, attitudes and prejudice; altruism and aggression; personal and social identities, conformity, group influence, moral and ethical issues, harassment,
- Corruption and its control, thinking processes and decision making.

Teaching Methodology (Proposed as applicable):
Lectures (audio/video aids), Written Assignments/Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/Field Visits, Group discussion, Report Writing

Assessment:
Mid Term, Report writing/Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:
Community Services

Area Scope:
Community service-learning provides a variety of benefits to the students and the community service has a unique way of developing an individual's leadership skills, sense of community, civic ethic, self-esteem, and other personal characteristics. Every service activity benefits a specific individual or group. Whether it is building homes for the poor, serving victims of chronic or terminal illness, tutoring children, addressing environmental needs or any other service, there is a person or group who ultimately benefits from your time. Finally, the organization where you conduct your service benefits enormously. Volunteers can make important contributions to Community benefit agencies (nonprofit) and government programs in their attempt to deal with the complex and growing needs of society.

Course Outline:

- Develop and implement service programs
- Develop workplace communication strategies
- Analyze impacts of sociological factors on clients in community work and services
- Manage and promote diversity
- Manage legal and ethical compliance
- Facilitate workplace debriefing and support processes
- Reflect on and improve own professional practice
- Manage work health and safety
- Assess co-existing needs
- Coordinate complex case requirements
- Develop, facilitate and review all aspects of case management
- Provide case management supervision
- Undertake project work
- Lead and manage team effectiveness
Curriculum of Telecom Engineering / Electrical Engineering (Telecom)

- Manage personal work priorities and professional development
- Manage meetings

**Teaching Methodology (Proposed as applicable):**

Lectures (audio/video aids), Written Assignments/Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/Field Visits, Group discussion, Report Writing

**Assessment:**

Mid Term, Report writing/Presentation, Assignments, Project Report, Quizzes, Final Term

**Suggested Books:**


**Organizational Behavior**

**Course Outline:**

**Introduction to Organizational Behavior**

- Organizational Disciplines and topics
- Psychological Perspective
- Social-Psychological Perspectives

**Structure and Control in Organization**

- Introduction of Bureaucracy
- Managerial Work
- Contingency theory
- Organizational Design

**Individual and Work Learning**

- Learning Theories
• Learning and Work

Stress
• Types of Stress and Work
• Occupational Stress Management

Individual Differences
• Personality and its factors
• Personality dimensions and social learning Intelligence

Motivation and Job Satisfaction
• Needs at Work
• Theories of Motivation and job satisfaction
• Correlates of Job satisfaction
• Correlates of Job satisfaction

Group and Work
• Social Interaction
• Dramaturgy and impression Management
• Social Skill

Group and Inter Group Behavior
• Group Structure & Norms
• Group Processes
• How throne Studies

Leadership
• Leadership as an attribute
• Leadership Style

Patterns of Work
• Work-the classical approach
• Marx, Weber, & The critique of labor
• Foucault & Disciplinary Power
• Conflict and Consent in Work
• The labor Process debate
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- Work place control and resistance
- Industrial conflict and industrial relations

Organizational Culture

- Organizational culture and strategic management
- Exploring organizational culture
- Evaluating concept of culture

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:


Professional Ethics

Area Scope:

The objective of this course is to grasp ideals and principles as they have been spelled out in a variety of traditional ethical systems and to apply these conceptual structures and guidelines to major problems and dilemmas of engineering practices in a corporate culture.
Course Outline:

- Engineering Ethics, Ethical concepts, and Types
- Moral Autonomy, Kohlberg’s & Gilligan’s Theory
- Profession and Professionalism
- Moral Reasoning, Ethical Theories
- Critique codes of ethics
- Moral frameworks, Personal commitments and professional life
- Engineering as social experimentation
- Involving the public in the design process, Case studies for engineering as social experimentation
- Assessment of safety and risk, Design considerations, uncertainty
- Risk-benefit analysis, Safe-exit and fail safe systems
- Case Studies for the Design Process Case studies in impact of safety/risk on design
- Employee/employer rights and responsibilities
- Confidentiality and conflict of interest
- Whistle-blowing, case studies on professional behavior/policies on the job
- Environment, sustainable development, Multinational corporations, globalization of engineering

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Fundamentals of Engineering Economics, 3rd ed., by Chan S. Park
- The Seven Habits of Highly effective people by Stephan r. Covey
Cultural Courses

Islamic Studies and Ethics

Course Description:
The Islam is a religion of peace and harmony for all humans based on knowledge and guidance in the Holy Quran. The basic teachings of Islam are comprehensive, practicable and universal. Therefore, this course briefly presents the vision of life and applied aspects of ethical system.

Area Scope:
- To enhance understanding of Islamic Culture and Civilization
- To understand values and social system in Islam
- To improve students’ ethical and professional skill and critical thinking

Course Outline:

Islam – Religion of Peace and Harmony
- Basic Concepts – Islam, Quran and Hadith
- Faith and Religious Life
  - Selected Verses of Surah Al-Baqara Related to Faith (Verse No-284-286)
  - Selected Verses of Surah Al-Mumanoon Related to Characteristics of Faithful (Verse No-1-11)

Islamic Culture and Civilization
- Basic Concepts and of Characteristics of Islamic Culture and Civilization
- Education System of Islam
- Political System of Islam – Dynamics, Sovereignty and Institutions
- Economic System of Islam – Principles, Riba, Trade and Commerce
- Acceptance of Other Religions – Interfaith Harmony
- Foreign Policy
Social System of Islam

- Basic Concepts of Social System in Islam
- Elements of Family and their Rights - Parents, Women, Husband & Wife, Children
- Inheritance – Rights and Laws
- Social Rights – Neighbors, Relatives and Society
- Equality and Brotherhood
  - Selected Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
- Concept of Welfare State – Period of Khilafat-e-Rashida

Professional Ethics and Morality

- Basic Concepts - Islam and Ethics
  - Selected Verses of Surah Al-Inam Related to Ihkam (Verse No-152-154)
- Profession and Professionalism in Islam
- Characteristics of a Professional
  - Truthfulness, Honesty, Sincerity, Patience, Gratitude, Meditation and Research
- Role for Human Safety and Environment
- Time Management
- Prophet Muhammad (PBUH) – Role Model
  - Selected Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
  - Selected Verses of Surah Al-Ihzab Related to Adab Al-Nabi (Verse No. 6, 21, 40, 56, 57, 58)

Islam and Science

- Islam and Science
- Role of Muslims in Science and Education
- Critical Thinking and Innovation
  - Selected Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
  - Selected Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No1,14)
**Note:** All topics should be taught/covered in the light of relevant Verses from Holy Quran and Ahadiths.

**Teaching Methodology (Proposed as applicable):**

Lectures (audio/video aids), Written Assignments/Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/Field Visits, Group discussion, Report Writing

**Assessment:**

Mid Term, Report writing/Presentation, Assignments, Project Report, Quizzes, Final Term

**Suggested Books:**

- Al-Qur’ān (selected text).
- Khurram Murad, رب کا پیغام (Lahore: Manshūrat, Mansoora, 2000)
- Hameed ullah Muhammad, “Emergence of Islam”, Islamic Research Institute (IRI), Islamabad
- Hameed ullah Muhammad, “Muslim Conduct of State” Sh Muhammad Ashraf, Kashmir Bazar, India (Latest Edition)
- Hameed ullah Muhammad, “Introduction to Islam” Compiled by The CSS Point, www.thecsspoint.com
Pakistan Studies and Global Perspective

Area Scope:
The knowledge units in this area collectively encompass the following:

- Have a better understanding of the rationale for the creation of Pakistan.
- Enable students to contribute in social, political and economic growth of Pakistan.
- Become a part of strong nation with a sense of ownership and responsibility towards Pakistan.
- Play an active role toward sustainable development of Pakistan in global perspective.

Course Outline:

<table>
<thead>
<tr>
<th>Historical and Ideological Perspective</th>
<th>Time Duration</th>
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<tr>
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<td>a. Pakistan Movement</td>
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<td>- Aligarh Movement</td>
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<td>- Two Nations Theory</td>
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<td>b. Founders of Pakistan</td>
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<td>- Allama Muhammad Iqbal</td>
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<td>- Quaid-e-Azam Muhammad Ali Jinnah</td>
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<td>- Other Leaders (Women and other Pakistan Movement Leaders)</td>
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<td>c. Quaid’s Vision for Pakistan</td>
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<td>d. Kashmir – An unfinished Agenda of Partition</td>
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<th>Constitution of Pakistan</th>
<th>4 hrs</th>
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<td>a. An overview of constitutional development in Pakistan</td>
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<td>b. Salient features of the Constitution of 1973</td>
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<td>c. Constitutional Amendments</td>
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<td>d. Fundamental Rights and Responsibilities of Citizens</td>
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Curriculum of Telecom Engineering / Electrical Engineering (Telecom)

Contemporary Pakistan 4 hrs
a. Pakistan’s society, culture and demography – celebrating diversity
b. Current Challenges: social, economic, environmental, political and external
c. Nation’s resilience in War on Terror

Economy of Pakistan 4 hrs
a. An overview of Economy
b. Services, Manufacturing and Agricultural Profile of Pakistan
c. Regional Economic Cooperation
d. One Belt One Road (OBOR) – CPEC

Land of Opportunities 4 hrs
a. Physical features: diversity and beauty
b. Natural resources - mineral, water, energy, agriculture & livestock, and marine resources
c. Tourism and Culture

Pakistan’s Foreign Policy 5 hrs
a. Foreign Policy – Principles and Objectives
b. Relations with Neighbors
c. Major Economies
d. Muslim World
e. Geo-political and strategic significance of Pakistan in Regional and Global Politics

Pakistan in pursuit of Global Agenda 4 hrs
a. SDGs-2030 - Pakistan Goals
b. Commitments on Climate Change
c. Peace and Security

Teaching Methodology (Proposed as applicable):
Lectures (audio/video aids), Written Assignments/Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing
Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Shahid M. Amin, Pakistan’s Foreign Policy: A Reappraisal, Oxford University Press, 2010.
- Hamid Khan, Constitutional & political history of Pakistan, Oxford University Press, 2003
- Ziring Lawrence, Pakistan in the Twentieth Century, Oxford University Press, 1997
- Burke S. M. & Ziring Lawrence, Pakistan’s Foreign Policy, Oxford University Press, 1973. Mohammad Qadeer, Pakistan
- Sustainable Development Goals (SDGs)- www.pc.gov.web/sdg/sdgpak
- Foreign Policies-Ministry of Foreign Affairs, Pakistan http://mofa.gov.pk/
- Pakistan's Foreign Policy: A Reappraisal by Shahid M. Amin. ISBN: 0195798015
- Newspapers editorial and selected journalistic writings on current affairs.
- Pakistan (Lands, Peoples, & Cultures) by Carolyn Black, Bobbie Kalman. ISBN: 0778797147
Management Sciences Courses

Engineering Project Management

Area Scope:

The primary objective of this course is to get the fair understanding of core issues pertaining to Engineering Project Management. This course is aimed at providing both basic and some advanced exposure to emerging trends in the field of Project Management, so as to enable the engineering professionals of tomorrow to successfully complete sophisticated projects within the constraints of capital, time, and other resources with due regards to stakeholders set of expectations. Engineering students will learn key Project Management skills and strategies and will be able to face emerging challenges.

Core Objectives of this course are:

- To develop competencies in project costing, budgeting, and financial appraisal;
- To gain exposure to project Planning Control and Management, using standard tools and schedule variance analysis;
- To appreciate the elements of risk and quality in hi-tech projects;
- To learn Project Management by “practice”, through the medium of “End of Semester Group Project”; and
- To appreciate and understand the use of computers in Project Management, especially a tool like MS Project & Primavera etc.

Course Outline:

Project Management Concepts


Project Proposal Development

Project Proposal, Characteristics of good proposal, Types of Proposals, Request for Proposal, Request for Quotation etc.). Proposal Templates etc.
Project Feasibility

Brief review of various aspects of Project Feasibility like Technical, Social, Managerial, Economic, Financial & Marketing, Administrative etc.

Project Selection Criteria (Economic Analysis of Engineering Projects)

Using Break Even Analysis, Cost Benefit Ratio, Internal Rate of Return, Net Present Value etc.

Project Contract & Procurement Management

Engineering contracts, Type of contracts, understanding of procurement Process & Cycle, PPRA Rules

Project Planning and Scheduling

Project Planning (Resource & HR Planning), Work Breakdown Structure, Project Network & Scheduling, Manning Schedule and Activity Charts, Critical Path Method (CPM)/Project Evaluation & Review Techniques

Project Costing & Estimation


Project HRM & Communication Management

Effective organization and communication for Successful Projects, Project Organizational Structures (Project matrix and project based organizations), Project HR Plan preparation, HR Need Assessment and HR Matrix, Building and Managing effective project team, Selection & control mechanism of HRM in Projects, Effective Communication Plan.

Project Risk Management


Computer Application in Project Management

Basic/Elementary Introduction and hands on basic exposure of use of MS Project & Primavera P6 Software in Project Management
Project Quality Management

Defining Quality, Quality Assurance, Quality Management, 7 Quality Improvement Tools as applied to Project Management, Project Quality Management Plan, Quality Management Processes and Strategies

Project Closure & Termination

Project Evaluation, defining project success, Project Completion Criteria, Project Audit, Project Termination & When to close a project, the termination process, Project Close Up & lesson learnt, & Project Archive

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Frame, J. D. Managing projects in organizations. San Francisco: Jossey-Bass

Entrepreneurship

Area Scope:
• Develop a business plan with an appropriate business model
• Demonstrate the ability to provide a self-analysis in the context of an entrepreneurial career
• Demonstrate the ability to find an attractive market that can be reached economically

Course Outline:
• Basic Concept-Entrepreneurship
• Innovation and Entrepreneurship
• Basic Plan Development Cycle
• Intellectual Rights
• Financial and Legal Modalities
• Marketing
• Industrial Competiveness
• Gap Analysis, Critical Thinking and Idea Generation
• Business Plan Development
• Successful Case Studies (local)
Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Peter F. Drucker: Innovation and Entrepreneurship Peter F. Drucker, latest edition.
Principles of Management

Area Scope

- The focus will be on the learning fundamental principles of management and of managing people and organization.
- Develop analytical and conceptual framework of how people are managed in small, medium and large public and private national and international organizations.

Course Outline:

- Introduction, overview and scope of discipline
- The evolution and emergence of management thought
- Management functions
- Planning concepts, objectives, strategies and policies
- Decision making
- Organizing: departmentalization, line/staff authority, commitments and group decision making
- Staffing: principles of selection, performance, career planning
- Leading: Motivation, leadership, communication
- Controlling: the system, process and techniques of controlling
- Management and Society: future perspective

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

Engineering Management

Course Outline:

- Industrial networks
- Fundamentals of Product and Process development
- Business Community and New Generations of Managers
- Practical Skills Knowledge and Experience in Commercialization of New Technological Inventions
- Use of Multidisciplinary Science Based Knowledge,
- Problem Solving, Teamwork and Outreach Activity,
- Major steps in proof of concept to intellectual property protection,
- Prototype development
- Fabrication and assembly routes
- Materials procurement,
- Identification and creation of new markets
- Development of business plan
- Appropriate technology and marketing
- Distribution and financing
- Routes and strategies for specific technology under development.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:
