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**DEPARTMENT OF ELECTRICAL ENGINEERING**

**Course Descriptive File**

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| 1 | Course Title | Transmission and Switching Systems |
| 2 | Course Code | EE-420 |
| 3 | Credit Hours | 3 |
| 4 | Pre-requisites | Analog & Digital Communication |
| 6 | Semester | VII |
| 7 | Resource Person | Sajjad Rabbani |
| 8 | Contact Hours (Theory) | 48 |
| 9 | Contact Hours (Lab) | 0 |
| 10 | Office Hours | 8-4pm |
| 11 | Email | sajjadra94@gmail.com |
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| 12 | Course Outline as per Scheme of Studies ( SoS) | |
| Transmission Systems including PDH and SDH, Synchronization, Routing techniques, Line Encoding Techniques (e.g. HDB3, 2B1Q) ,Types of Switching, Review of switching technologies, Circuit, Message and Packet Switching, Digital Telephone Network basics including packet based networks , Telecommunication Network (PSTN, PLMN), Next generation network based protocols ,Exchanges Hierarchy, Basic functions of a Circuit base and Packet base Digital Switching Exchanges, SPC, Software Structure of SPC Digital Switches, Telecommunications Traffic and models including characterization of PABX and Public exchange traffic, GOS, BHCA, Network Traffic Load and Parameters, 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 ,Iintelligent Networks Associated Signaling (CAS) and Common Channel Signaling (CCS) ,SS 7 Signaling call flow problems and troubleshooting. | | |
| 13 | Course Objectives as per SoS | |
| * Provide an in-depth investigation of fundamental Telecommunication Engineering concepts, terminology and standards. * This course provides an introduction to the techniques of design, implementation, and analysis of telecommunications networks. * This course provides the students with the basic understanding of the concepts and principles of, transmission Systems, optical fiber communications, public switched telephone networks, teletraffic engineering, digital transmission system standards, network planning and principle of digital switching systems. * Public and private telecommunication networks will be examined. * Overview of Telecommunication Industry Trends in Pakistan, regulatory bodies, major   telecommunication operators, major telecommunication services and activities   * On completion of the course, the students will be able to apply the knowledge and principles to analyze, design, install and manage typical wired and wireless communication systems and networks in Telecommunication industry. | | |
| 14 | Books | |
| **Textbook**   1. J. E. Flood, “Telecommunication Switching, Traffic and Networks” First Edition, 1995, Prentice Hall, ISBN-13: 978-0130333094.   **Reference Books**   1. John Bellamy, “Digital Telephony”, Third Edition, 2000, Wiley Inter science, ISBN-13: 978-0471345718. 2. Roger L. Freeman, “Telecommunications Transmission Handbook”, Fourth Edition, 1998, Wiley , ISBN-13: 978-0471672487. 3. David R. Smith, “Digital Transmission Systems”, Third Edition, 2012, Springer, ISBN-13: 978-1461347262. 4. Wayne Tomasi “Introduction to Data Communication and Networking” | | |
| 15 | Course Learning Outcomes (CLOs) | |
| After successful completion, students will be able:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Sr. No.** | **Example CLO** | **Domain** | **Taxonomy level** | **PLO** | | **1.** | Acquire the basic knowledge of Transmission and switching used in telecommunication network. | Cognitive | C1,C2 | 1 | | **2.** | Understand transmission, switching, access network, MUX standards, switching modes, telecom networks, exchange hierarchy, signaling, telecom management and enterprise networks, SS7 signaling call flow diagram. | Cognitive | C1,C4 | 1 | | **3.** | Solve, Analyze and Evaluate the problems using imagination and calculation while tackling different switching and transmission problems. | Cognitive | C1,C4 | 2 |   **Theory CLOs:**   1. Transmission Systems including PDH and SDH & Line Encoding Techniques. 2. Types of Switching. 3. Digital Telephone Networks. 4. Exchanges Hierarchy. 5. Telecommunications Traffic and models. 6. Digital switching exchanges software structure of SPC digital switches, Optical fiber communication types ,limitations, mode of propagation, losses, Line Codes for Fiber Optic Transmission, routing techniques, software life cycle . 7. Channel SS7 signaling components (CAS & CCS). 8. SS7 Signaling call flow problems and troubleshooting.   **Lab CLOs**  Nill | | |
| 16 | Marks Breakup | |
| |  |  |  |  | | --- | --- | --- | --- | | Quizzes | | 10% | | | Homework/assignments | | 10% | | | Midterm exam | | 30% | | | Terminal exam (3 hours) | | 50% | | | Total (theory) | 100% | |   Theory   |  |  | | --- | --- | | Lab Assessments | 0% | | Lab Sessional Exams  (xx% Lab performance + xx% Lab Assessments) | 0% | | Lab Terminal Exam  (xx% Lab performance + xx% Lab Assessments) | 0% | | Total (lab) | 100% |   Lab   |  |  | | --- | --- | | Final marks | Theory marks 100 + Lab marks \* 0=100 | | | |

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| **17** |
| **Week** | **Topic** | **CLO** | **Taxonomy**  **Level** | **Specific Outcome** | **Contact Hours 3 hrs /wk** | **Assessment** |
| 1 | Introduction of Transmission & Switching systems in telecommunication networks.  Detail of multiplexing FDM/TDM & fundamental principles.  Space division multiplexing SDM, CDMA, Digital transmission  Need of synchronization,.  T1 carrier system detail & related calculations. E1,E2,E3 &E4 PCM TDM /transmission Calculations.  Introduction to PDH/SDH. Limitations of PDH &SDH  Data rates & Calculations. | CLO1 | C1,C2 | Understand and possess the basic concepts, principles and tools for the description of Telecommunication Transmission & Switching Network.  Describe basic principles of operation in modern digital telecommunication equipment. Students will get to know transport technologies, transmission impairments, systems design, multiplexing techniques, T1, E1 ,PDH & SDH systems etc. Provide an in-depth investigation of fundamental Telecommunication Engineering concepts, terminology and standards.  This course provides an introduction to the techniques of design, traffic design, implementation, and analysis of telecommunications networks.  This course provides the students with the basic understanding of the concepts and principles of, transmission Systems, optical fiber communications, public switched telephone networks, teletraffic engineering, digital transmission system standards, network planning and principle of digital switching systems.  Public and private telecommunication networks will be examined.  Overview of Telecommunication Industry Trends in Pakistan, regulatory bodies, major  telecommunication operators, major telecommunication services and activities  Describe and analyze the operation of various design parameters by using mathematical expression in telecommunication transmission networks  On completion of the course, the students will be able to apply the knowledge and principles to analyze, design, install and manage typical wired and wireless communication systems and networks in Telecommunication industry. | 3 | Assignment 1  Quiz 1 |
| 2 | PDH & SDH Transmission Systems detail and calculations, Synchronization & digital carrier frame synchronization design parameters. Types of Switching systems, Functions of switching systems. | CLO | C2 |  |  |
| 3 | Review of switching technologies  Circuit, Message and Packet Switching. Routing techniques detail.  Line Encoding Techniques details(e.g. HDB3, 2B1Q)  . | CLO | C2 |  |  |
| 4 | Telecommunication Infrastructures (PSTN, PLMN), Digital Telephone Network basics including packet based networks, Elements of Digital switching systems & Terminology | CLO | C2 |  |  | Assignment 2  Quiz 2 |
| 5 | Design & Exchange Hierarchy :  PSTN network configurations introduction (Mesh, Bus, Ring, Star & Tree)  Calculation of total number of nodes and lines & Examples.  Cost effective analysis of PSTN layout.  National Telecommunication network detail—customer lines, junction circuits, trunk circuit and class 5, 4 switches local exchanges, local tandem exchanges-primary trunks, regional tandem exchanges secondary trunks. National tandem exchanges & international gateways exchanges. | CLO | C 1,C2 &  C 4 |  |  |
| 6 | State transition diagram for a local call.  Subscriber signaling, DTMF & Pulse dialing  Subscriber loop design:  Design(attenuation , voltage drop ), Loop length calculations & numerical,  Fundamental characteristics of BORSCH &(SLI C) circuit for a digital exchange.  Limiting Factors of Subscriber Loop. Transmission impairments:  Impulse noise and inter-modulation noise, Cross talk, NEXT AND FEXT,etc | CLO | C2 & C3 |  |  |
| 7 | Calculation of Hybrid circuits along with Echo, singing path & stability calculations & numericals  Basic Functions of a Circuit base and Packet base Digital Switching Exchanges, SPC switch, Software Structure of SPC Digital Switches | CLO | C2 &C4 |  |  |  |
| 8 | Calculations of availability & un availability of single & dual processors calculations & numerical. Digital switching systems hardware architecture and Low levels , mid levels & high level controls. | CLO | C2 &4 |  |  |
| 9 | Comparison of single & multistage network & calculations.  Overview and detail of Hardware Architecture & Software of Digital switches: (, SIEMEN, AXE-10 & HUAWEI Technologies etc ) | CLO | C2 & C4 |  |  | Assignment 1  Quiz 1 |
| 10 | Detail of Hardware Architecture & Software of EWSD digital switch. Telecommunications Traffic, (traffic units types ) and models including characterization of PABX and Public exchange traffic ( Traffic measurements & mathematical model )  Calculations & Numerical | CLO | C1,C2 &C4 |  |  |
| 11 | Traffic units Traffic model analysis, GOS detail, BHCA, Network Traffic Load and Parameters.  Calculations & numerical of traffic engineering. | CLO | C2 & 4 |  |  |
| 12 | Optical fiber communication transmission advantages, limitations & line diagram. Physics of light & propagation through optic fiber.  Snell’s law, critical angle.  Optical fiber modes calculations Optical fiber classifications & Index profiles.  Calculations & Numerical | CLO2 | C1,C2&C4 |  |  | Assignment 2  Quiz 2 |
| 13 | Optical fiber comparison, losses in optical fiber cables  Line Codes for Fiber Optic Transmission, routing techniques,  Numerical | CLO | C2&C4 |  |  |
| 14 | Signaling techniques and classifications:  In channel signaling.  Multi –frequency AC signaling  Voice frequency signaling (in band/ out band signaling) & introduction of common channel signaling, comparison of In Channel and Common channel signaling  Detail of ATM  ISDN BRI & PRI networks. | CLO | C1,C2& C3 |  |  |
| 15 | Networks Associated Signaling (CAS) and Common Channel Signaling (CCS):  Features of SS7,  Channel SS7 signaling components, SS7 network architecture.  SS7 protocol architecture | CLO | C1 & 2 |  |  |  |
| 16 | SS 7 Signaling call flow problems and troubleshooting  Channel associated mode, channel non-associated mode & quasi associated mode.  Reviewed some topics. | CLO | C1 & 2 |  |  |
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| **18** | **Course Learning Outcomes (CLOs) and Assessment Plan** |
| |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | CLO  Activity | CLO 1 | CLO2 | CLO3 | LAB CLO1 | LAB CLO2 | LAB CLO3 | | | Quiz 1 | C1 | C2 |  |  |  |  | | Quiz 2 | C1 | C2 |  |  |  |  | | Quiz 3 |  |  |  |  |  |  | | Assignment 1 | C1 | C2 |  |  |  |  | | Assignment 2 | C1 | C2 |  |  |  |  | | Assignment 3 |  |  |  | - | - | - | | MID TERM EXAM | C1, C2, C3 | | | - | - | - | | Quiz 1 |  | C2 | C3 | - | - | - | | Quiz 2 |  | C2 | C3 |  |  |  | | Quiz 3 |  |  |  |  |  |  | | Assignment 1 |  | C2 | C3 |  |  |  | | Assignment 2 |  | C2 | C3 |  |  |  | | Assignment 3 |  |  |  |  |  |  | | FINAL TERM EXAM | C1, C2, C3 | | | - | - | - | | Lab Final Exam | - | - | - |  |  |  |   \*Add columns according to number of course CLO’s and Lab CLO’s for your respective course. Complete as per your planned quiz and assignments for this session. | |

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| **19** | **Lab Details** | |
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| **Laboratory Resources** | | |
| * Hardware based   - | | |
| **Computer Resources** | | |
| * Software based   - | | |
| **20** | | **Mapping of CLOs to PLOs** |

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| PLO  CLOs | PLO1 | PLO2 | PLO3 | PLO4 | PLO5 | PLO6 | PLO7 | PLO8 | PLO9 | PLO10 | PLO11 | PLO12 |
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| CLO1 | C1 |  |  |  |  |  |  |  |  |  |  |  |
| CLO2 | C2 |  |  |  |  |  |  |  |  |  |  |  |
| CLO3 |  | C3 |  |  |  |  |  |  |  |  |  |  |
| CLO4 |  |  |  |  |  |  |  |  |  |  |  |  |
| LAB CLO1 |  |  |  |  |  |  |  |  |  |  |  |  |
| LAB CLO2 |  |  |  |  |  |  |  |  |  |  |  |  |
| LAB CLO3 |  |  |  |  |  |  |  |  |  |  |  |  |

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| **21** | **List of Experiment With Objectives as Per OBE Format** |
| |  |  | | --- | --- | | **Lab Experiment No.** | **Title and Objectives** | | **1** | **Title:**  Objectives  **-** | | **2** | **Title:**  Objectives  - | | **3** | - | | **4** | - | | **5** | - | | **6** | **-** | | **7** | - | | **8** | **-** | | **9** | - | | **10** | - | | **11** | - | | **12** | - | | **13** | - | | **14** | - | | **15** | - | | **16** | - | | |

**\*title and objective to be achieved in every experiments**