

# Thematic Topics for the Master Final State Exam

Master study program **Electronics and Communications**  
**Branches Communication Networks and Internet and Mobile Communications**

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## Common Topics

1. Architectures and types of processors. Types of memories and buses. Address and I/O space. Internal peripheral devices, I/O space expansion. Peripheral and communication buses. Communication between processors. (BE2M37MAM)
2. Programming of processor, machine code, assembler, higher programming, languages, interrupt system, pipeline. Programming techniques, multiprocessor systems, parallel systems. (BE2M37MAM)
3. Applications of correlation, spectral, and cepstral analysis. Estimation of delay between two signals, noise cancellation and signal restoration. (BE2M31DSPA)
4. Signal decomposition into principal and independent components (PCA, ICA) and its usage for signal separation. Discrete wavelet transform. (BE2M31DSPA)
5. Medium access protocols in wireless networks, network topology and data transmission in Bluetooth, routing in wireless sensor networks, principle of RFID. (BE2M32BTSA)
6. Principle of communication in Wi-Fi networks, MQTT, LoRa, SigFox, and IQRF protocols, communication chain for service provisioning in IoT, reliability and security of wireless and sensor networks. (BE2M32BTSA)

## Specialized Fields

**Branch Communication Networks and Internet**

1. NGA access networks, access network topology and architecture. Modeling of telecommunication lines parameters. Types of digital subscriber lines. (BE2M32PRSA)
2. Optical access networks, passive optical networks, use of wavelength multiplexing and design of access networks, attenuation link budget. (BE2M32PRSA)
3. IP packet routing principles and distributed routing algorithms. IP multicast routing. IPv6 network architecture. Transport protocols (TCP, UDP, SCTP) and their use. Data flow control and network congestion avoidance, active packet queue management. (BE2M32PST)
4. MPLS network architecture and services provided by MPLS networks. Software defined networks (SDNs) and their use. Virtualization of network functions, HW and SW architecture of network elements. (BE2M32PST)
5. Definition, classification and basic properties (energy, spectral) of digital modulations. Models of communication channels. Demodulator, metric (correlation, signal space, SODEM). Communication channel sharing. (BE2M37DKM)
6. Principles of block, convolutional and TCM codes. Decoding (symbol, sequence, MAP, ML). Viterbi algorithm. Decoder error rate (union bound). (BE2M37DKM)
7. Digital switching systems, switch matrix. Switching system control, signaling in switching systems (CAS and CCS), signaling SS7 - message routing, protocols for ensuring signaling transmission. (BE2M32RTK)
8. Intelligent networks, IP telephony, quality and its assurance and evaluation, IMS systems, H.323 signaling protocols, SIP / SDP, RTP / RTCP communication protocol, voice communication in mobile network - VoLTE. (BE2M32RTK)
9. Optical amplifiers (Raman, EDFA, SOA), wavelength converters and optical signal regeneration (1R, 2R, 3R), optical filters, optical switches and their use. Optical systems with wavelength multiplexing (attenuation, noise, nonlinear and dispersion budget). (BE2M32OSS)
10. Optical coherent systems and high-order modulations (optical systems with speeds of 100 Gbit/s and higher), optical networks and architectures, principles of optical circuit, packet and burst switching, optical network elements, optical data interfaces, network clock. (BE2M32OSS)

# Specialized Fields

## Branch Mobile Communications

1. Architectures of mobile networks (2G, 3G, 4G, 5G), data and speech transmission and processing in mobile networks, quality of service. (BE2M32MKSA)
2. Methods of multiple access in mobile networks, error correction (ARQ, HARQ) random access procedure, scheduling, principle and types of handover, methods for interference mitigation. (BE2M32MKSA)
3. Definition, classification and basic properties (energy, spectral) of digital modulations. Models of communication channels. Demodulator, metric (correlation, signal space, SOSEM). Communication channel sharing. (BE2M37DKM)
4. Principles of block, convolutional and TCM codes. Decoding (symbol, sequence, MAP, ML). Viterbi algorithm. Decoder error rate (union bound). (BE2M37DKM)
5. IP packet routing principles and distributed routing algorithms. IP multicast routing. IPv6 network architecture. Transport protocols (TCP, UDP, SCTP) and their use. Data flow control and network congestion avoidance, active packet queue management. (BE2M32PST)
6. MPLS network architecture and services provided by MPLS networks. Software defined networks (SDNs) and their use. Virtualization of network functions, HW and SW architecture of network elements. (BE2M32PST)
7. Properties of electromagnetic wave propagation environments concerning a frequency spectrum and wireless services, fundamental mechanisms of wave propagation in the atmosphere. Terrestrial and satellite fixed links - power budget, fading, propagation modeling, planning methods. (BE2M17SBS)
8. Mobile links - outdoor and indoor propagation in urban areas, empirical and deterministic models, statistical characterization of fading. Interference analysis for fixed links and cellular networks. Measurement methods for wireless links and networks. (BE2M17SBS)
9. Antenna as an circuit element - equivalent circuit, antenna parameters, polarization, elementary electric dipole, field components, radiation resistance, linear antennas, finite-length dipole, symmetrization, monopole antenna, radiation from aperture, Huygens source. (BE2M17ANT)
10. Horn antennas, reflector antennas, antenna arrays, wideband antennas - self-complementarity (examples), microstrip planar antennas. (BE2M17ANT)