📘 Unit 13 – New Trends & Future Directions in Computing (A/L ICT)

13.1 Intelligent & Emotional Computing

🔹 Intelligent Computing

- Machines that simulate human intelligence.
- Examples: AI, machine learning, expert systems, robotics.
- Features: self-learning, decision-making, adaptability.

🔹 Emotional Computing (Affective Computing)

- Machines that understand & respond to human emotions.
- Uses sensors, cameras, speech recognition.
- Applications:
  - Virtual assistants detecting frustration (e.g., Siri, Alexa).
  - Customer support chatbots adapting tone.
  - Healthcare: detecting depression, stress.

🔹 Artificial Intelligence (AI)

- Branch of computer science → enabling machines to think, learn, and act.
- Applications:
  - Self-driving cars (Tesla, Waymo).
  - Healthcare diagnosis (IBM Watson).
  - Finance (fraud detection, stock prediction).
  - Everyday apps (Google Translate, TikTok recommendations).

🔹 Man–Machine Coexistence

- Collaboration between humans and machines.

- **Examples:**
    - **Surgeons using robotic assistance (Da Vinci system).**
    - **AI-powered tutors supporting teachers.**
    - **Factories: humans + robots in production.**

🔹 Machine–Machine Coexistence (M2M)

- **Machines communicate without human involvement.**
- **Examples:**
    - **IoT (smart home devices).**
    - **Autonomous cars sharing traffic info.**
    - **Smart meters reporting electricity usage.**

13.2 Agent Technology

🔹 Software Agent

- **A program that acts on behalf of a user/system.**
- **Characteristics: autonomous, adaptive, goal-driven.**
- **Examples:**
    - **Email filters (spam detection).**
    - **Personal assistants (Cortana, Google Assistant).**

🔹 Multi-Agent Systems

- **Multiple agents working together.**
- **Features: collaboration, coordination, distributed problem-solving.**
- **Examples:**
    - **Smart grid management.**
    - **Online games (NPCs cooperating).**
    - **E-commerce (price negotiation bots).**

🔹 Applications

- **E-commerce: recommendation systems, auction agents.**
- **Robotics: swarm robots (like ants).**
- **Internet: search engines using crawlers.**
- **Healthcare: patient monitoring agents.**

13.3 Beyond von-Neumann Computers

🔹 Limitations of Von-Neumann

- **Sequential execution.**
- **Bottleneck between CPU & memory.**
- **Limited speed for massive computations.**

🔹 Nature-Inspired Computing

- **Algorithms inspired by nature.**
- **Examples:**
  - **Genetic algorithms (evolution principles).**
  - **Ant colony optimization.**
  - **Neural networks inspired by brain.**

🔹 Biology-Inspired Computing

- **Computing based on biological processes.**
- **Examples:**
  - **DNA computing.**
  - **Brain-computer interfaces.**
  - **Protein folding simulations.**

🔹 Quantum Computing

- **Uses quantum mechanics (qubits instead of bits).**
- **Features: superposition, entanglement, parallelism.**

- **Applications:**
    - **Cryptography (quantum-safe encryption).**
    - **Drug discovery.**
    - **Optimization problems.**
    - **Weather & climate prediction.**

🌍 Latest Trends & News (for modern papers)

Examiners often add current updates:

- **AI: ChatGPT, Google Gemini, AI in education, AI-generated deepfakes.**
- **Robotics: Boston Dynamics robots, AI-driven surgery.**
- **IoT: Smart cities, 5G enabling IoT.**
- **Quantum Computing: IBM Quantum, Google's "Quantum Supremacy" claim.**
- **Emotional AI: Cars detecting driver drowsiness.**
- **Agent Systems: Chatbots in e-commerce (Amazon, AliExpress).**
- **Biology computing: Brain–computer interface (Neuralink by Elon Musk).**
