I. Basics

A. Structures

1. What are structures?

2. Primary and secondary structures

- **a) Primary structures**
- **b) Secondary structures**
  - ***Brittle structures: fractures***
  - ***Ductile structures: flow***

3. Levels of structural analysis

- **a) Descriptive/Geometric**
- **b) Kinematic**
- **c) Dynamic**

4. Scales of structure

- **a) Microscopic**
- **b) Mesoscopic / Outcrop scale**
- **c) Macroscopic / Map scale**
  - ***Topographic and geologic maps***
  - ***Map scales and representative fractions***
  - ***Topographic profiles and cross sections***
  - ***Vertical exaggeration***

B. Geometric/Descriptive analysis

1. Orientation of lines and planes

- **a) Lines**
  - ***Trend***
  - ***Plunge***
  - ***Recording the data***
- **b) Planes**
  - ***Dip***
  - ***Strike***
  - ***Dip direction***
  - ***Recording the data***
- **c) Line in a plane**
  - ***Rake or pitch***
  - ***Recording the data***

2. Contour representations of lines and planes

- **a) Topographic contours**
- **b) Structure contours**
- **c) Linear features on contour maps**
- **d) Contours and cross-sections**
  - ***Apparent dip***
  - ***Vertical exaggeration***
- **e) Time-structure contours**

3. Stereographic representation of lines and planes

- **a) Principles**
  - ***Principle of stereographic (equal-angle) projection***
  - ***Wulff net***
  - ***Primitive, great and small circles***
- **b) Basic plotting operations**
  - ***Plot of a line***
  - ***Plot of a plane and its pole***
  - ***Plot of a line in a plane***
- **c) Calculations**
  - ***Plane common to two lines***
  - ***Angle between two lines***
  - ***Line perpendicular to two lines***
  - ***Intersection of two planes***
  - ***Plane perpendicular to two planes***
  - ***Angle between two planes***

- ***C. Kinematic analysis***
  - **1. The basic movements**
    - **a) Translation**
    - **b) Rotation**
    - **c) Dilation**
    - **d) Distortion**
      - ***Changes in length***
      - ***Changes in angles***
  - **2. Strain**
    - **a) Heterogeneous strain and homogeneous strain**
    - **b) Strain ellipse**
    - **c) Strain ellipsoid**
    - **d) Strain axes**
  - **3. Deformation histories**
    - **a) Rotational and non-rotational deformation**
    - **b) Finite and infinitesimal deformation**
    - **c) Coaxial and non-coaxial deformation**
      - ***Pure strain***
      - ***Simple shear***
- ***D. Dynamic analysis***
  - **1. Force and stress**
    - ***Units of force***
    - ***Units of stress***
  - **2. Stress on a plane**
    - ***Normal stress***
    - ***Shear stress***
  - **3. State of stress at a point**
    - ***Hydrostatic and Lithostatic stress***
    - ***Non-hydrostatic and differential stress***
    - ***Stress axes***
    - ***Effective stress***
  - **4. Stress-strain relationships**
    - ***Elastic***
    - ***Brittle***
    - ***Plastic***
    - ***Viscous***
    - ***Experimental vs. geological strain rates***

II. Primary structures

- ***A. Primary structures in sedimentary rocks***
  - **1. Stratification**
    - **a) Map-scale units: formations, groups, members**
    - **b) Outcrop-scale: bedding, lamination**
    - **c) Thickness calculations**
  - **2. Structures generated by currents, way-up indicators**
    - **a) Bedforms and cross-stratification**
    - **b) Sole markings**
  - **3. Structures generated by soft-sediment deformation**
- ***B. Primary structures in igneous rocks***
  - **1. Intrusions**
  - **2. Volcanic rocks**
- ***C. Unconformities***
    - **a) Disconformity**
    - **b) Angular unconformity**
    - **c) Nonconformity**