

## Exercise # 2

### Section 1:

1. a or d (Simplex or half duplex, defined differently in wiki and other sources)
2. d or Full duplex, to be more accurate
3. b
4. b

### Section 2:

1. Wireless transmission *distorts* any transmitted signal. Transmitted signal  $\neq$  received signal.
  - a. Reflection - bounce of a surface; e.g. mountain, building, vehicles
  - b. Refraction - enter material and then between media with different/slower speed of propagation (e.g. effect of sudden change in atmosphere's vertical moisture content and temperature profiles)
  - c. Diffraction – start “new wave” from a sharp edge, radio waves are bent around sharp edges
  - d. Scattering – multiple reflections at rough surfaces, e.g. ground, non-uniform surface of building, rain scattering, others: Lighting scattering, aeroplane scattering, etc)
  - e. Doppler effect – shift in frequencies (loss of center)- the apparent change in frequency and wavelength of a wave that is perceived by an observer moving relative to the source of the waves.
  - f. Interference-the superposition of two or more waves resulting in a new wave pattern.
2. **Multipath** is the propagation phenomenon that results in radio signals' reaching the receiving antenna by two or more paths. Factors: as in previous questions.
  - a. The effects of multipath include constructive and destructive interference, and phase shifting of the signal.
  - b. Problems with mobile nodes
    - i. Slow Fading: Shadowing or Large-Scale fading is a kind of fading caused by larger movements of a mobile or obstructions within the propagation environment
    - ii. Fast Fading: Multipath fading or Small-Scale fading is a kind of fading occurring with small movements of a mobile.
3. **Modulation** is the process of varying a periodic waveform, i.e. a tone, in order to use that signal to convey a message, in a similar fashion as a musician may modulate the tone from a musical instrument by varying its volume, timing and pitch.
  - a. Digital modulation, a digital bit stream by varying an analog carrier signal. This can be described as a form of digital-to-analog conversion.
  - b. All convey data by changing some aspect of a base signal, the carrier wave, (usually a sinusoid) in response to a data signal.
  - c. These are the most fundamental digital modulation techniques:
    - i. In the case of PSK, a finite number of phases are used.
    - ii. In the case of FSK, a finite number of frequencies are used.
    - iii. In the case of ASK, a finite number of amplitudes are used.