wherever needed:

Faculty of Science

Geology Department

Geophysics Branch (3th Level)

Final Exam., Saturday 14/1/2017

Marine Geophysics and Seismic Data Processing.

Time: 120 Minutes

Question No.	48 Marks
Answer the following questions, with sketches wherever needed:	**12**

1- Write briefly on the following:

a) Seismic Noises.

NOISES

Noise on a seismic reflection profile can be defined as the deflection of *a seismic trace caused by anything other than energy reflected once from an interface.* Noise can be natural, cultural, or induced by the seismic method itself.

- **Natural Noise**

Seismic receivers (geophones) can be shaken as the result of natural phenomena. The *wind* shakes trees, bushes, and other objects, causing vibrations of the ground that are recorded by the geophones. Likewise, *animals* walking near geophones, or *water* flowing in nearby streams can cause ground vibrations. Wind, rain, and animals can also shake the cables connecting geophones, causing the geophones to vibrate.

- **Cultural Noise**

Activities of people can contribute to noise. *Cars, trucks,* *trains, as well as people* walking near the survey line, cause the ground to rattle. *Electrical power lines* cause a magnetic field which can interfere with electrical systems of a seismic survey.

- **Noise Induced by Seismic Acquisition and processing**

The seismic reflection method attempts to image primary reflections (Figs.). Other seismic events, or phenomena introduced by acquisition or processing, interfere with the primary reflections. Rayleigh waves (also referred to as groundroll, Fig.) appear as low-frequency events cutting across the reflected arrivals. *Direct waves, critically refracted waves, and diffractions* (energy radiating from a point source) can also arrive at the same time as reflections (Fig.).

Multiple reflections (energy reflected more than once from the same interface) also interfere (Figs.).

Seismic surveys best attenuate noise when survey lines are straight and continuous. Surveys may have to skip or go around areas with buildings, highways, rivers or other obstructions, causing gaps or bends in the recorded data. Noise can also be introduced in the processing of data, through factors like over-migration or poor normal moveout corrections (Fig.).

b) Seismic Marine Acquisition.

ACQUISITION

Field geometries vary considerably according to the environment (land vs. marine), the nature of geologic problem, and the accessibility of the area. Geophones are designed to record only frequencies near that of the input signal (source), discriminating against noise outside source frequencies. Most geophones are designed to respond to motions that are vertical (Fig.); reflected compressional waves (vertical particle motion) are enhanced, at the expense of events that produce horizontal motions at the surface (direct compressional waves; reflected shear waves).

Receiver Arrays

Most surveys are designed so that the source (explosive; vibroseis; airgun; water gun) is fired into stations of receivers (geophones; hydophones). Each receiver station commonly is not a single instrument, but rather an *array* of several receivers, connected electronically and centered on a point (Fig.). The geometry of an array (or *geophone group)* is designed to cancel certain unwanted signals, while enhancing reflected events. Rayleigh waves an example of unwanted noise; they are also called *groundroll*, because the waves produce an up-and-down, rolling motion of the ground surface. The array can be proportioned to the wavelength of the groundroll, so that half the geophones in the array are moving down (Fig.). The corresponding positive and negative electrical signals sent by the geophones cancel, so that the groundroll is attenuated. Reflections commonly arrive at high angles to the ground surface, (that is, with high apparent velocity; see chapter 1). The result is that

geophones in the array move up and down in unison; their electrical signals add in phase, enhancing reflected signals at the expense of other arrivals (Fig.). 2- "Remote sensing has a wide range of applications in marine studies": write on these applications. *Remote sensing has a wide range of applications in marine studies:* Coastal applications: Ocean applications: Hazard assessment:	**8**
II- Chose the most accurate answer: **1-** Seismic Normal Moveout (NMO) correction can be best described as: **a)** Stacking the seismic traces. **b)** Putting seismic reflectors in their correct location. **c)** Adjusting the reflection time based on the hyperbolic travel time. **2-** Acoustic impedance, involving ________, is a compound parameter that can be used to describe the efficiency of seismic reflection and transmission. **a)** Velocity and density. **b)** Critical angle and velocity. **c)** Reflection and transmission coefficients. **d)** Layer thickness and velocity.	**18**

3- In multiples:

a) Long-path multiples are less obvious than most short-path multiples and are less easily removed by seismic processing.

b) Short-path multiples are less obvious than most long-path multiples and are less easily removed by seismic processing.

c) Short-path multiples and long-path multiples are easily removed by seismic processing.

4- Normal moveout corrections are determined not just for one event, but for several prominent reflections in a CMP gather. Commonly:

a) A deeper reflection is corrected for T_{NMO} with a lower velocity than that used for a shallower event.

b) A deeper reflection is corrected for T_{NMO} with a higher velocity than that used for a shallower event.

c) A deeper reflection is corrected for T_{NMO} with equal velocity to that used for a shallower event.

5- In m**igrated time correction:**

a) It removes multiple-branch reflections, synclines get broader and anticlines get narrower.

b) Migration removes multiple-branch reflections, synclines get narrower and anticlines get broader.

c) Migration removes multiple-branch reflections, synclines and anticlines get narrower.

6- Prior to stacking, the data must be:

a) Corrected for the normal moveout of the reflections **b)** Filtered to remove noise. **c.** Add or subtract time to traces within CMP gathers (Static correction). **d)** Do all of these (a, b and c).	
III- Complete the following statements: **1-** In static correction, time is added or subtracted to traces within CMP gathers according to the source and receiver elevations relative to a horizontal datum plane. **2-** The number of traces that have been added together during seismic time stacking is called the *fold*. **3** The pulses produced by airguns and dynamites are minimum phase while which produced by vibroseis are zero phase. **4-** Time migration has the effect of moving dipping events on a surface seismic line from apparent locations to their true locations in time. **5-** A migrated time section attempts to move events to their true horizontal positions, relative to common source/receiver positions on the surface.	**10**

With best wishes

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