1. (a) State the range of wavelength (in metres) used in microwave remote sensing. (2 marks)

(b) With the aid of a labelled diagram, explain the passive microwave remote sensing. (10 marks)

(c) Explain the application of passive microwave remote sensing in the following disciplines:

(i) meteorology; (2 marks)
(ii) hydrology; (2 marks)
(iii) oceanography; (2 marks)
(iv) forestry. (2 marks)

2. (a) Write in full the following acronyms as used in remote sensing:

(i) RADAR; (1 mark)
(ii) LIDAR; (1 mark)
(iii) SONAR. (1 mark)

(b) Explain the principle of remote sensing used in each of the following:

(i) RADAR; (3 marks)
(ii) LIDAR; (3 marks)
(iii) SONAR. (3 marks)

(c) State **two** types of RADAR remote sensing. (2 marks)

(d) State **three** advantages of microwave remote sensing. (3 marks)

(e) Give **three** types of each of the following remote sensing sensors:

(i) imaging sensors; ($1\frac{1}{2}$ marks)

(ii) non-imaging sensors. ($1\frac{1}{2}$ marks)

3. (a) Describe polarization as used in RADAR remote sensing. (5 maarks)

(b) With the aid of labelled diagrams, explain:

(i) like polarized; (6 marks)
(ii) cross polarized. (6 marks)

(c) State **three** components of RADAR system. (3 marks)

4. (a) (i) State **three** remote sensing platforms. (3 marks)

(ii) Give **one** example of each of the platform named in (i). (3 marks)

(b) (i) Define the term 'orbit' as used in remote sensing. (1 mark)

(ii) (I) Explain the **three** types of satellite orbits. (9 marks)

(II) Give **one** example of satellite orbiting in each of the orbits named in (i). (3 marks)

(c) Name the electromagnetic radiation with the highest frequency. (1 mark)

5. (a) Table I shows various electromagnetic radiation (EMR) and their wavelength range and bands used in landsat sensor. Study and use it to answer the questions that follow:

Table 1:

EMR	**Wavelength range (micrometers)**	**Band**
Thermal infrared	X	6
Blue	Y	1
Green	Z	2
A	0.76 - 0.90	Q
B	1.55 - 1.75	R

(i) State the wavelength ranges represented by letters X, Y and Z. (6 marks)

(ii) Identify the electromagnetic radiations (EMR) represented by letters A and B. (2 marks)

(iii) Name the bands represented by letters Q and R. (2 marks)

(iv) State one application of each of the following electromagnetic radiations:

(I) Thermal infrared; (1 mark)

(II) Blue; (1 mark)

(III) A; (1 mark)

(IV) B. (1 mark)

(b) Explain **three** types of resolutions used in remote sensing. (6 marks)

6. (a) (i) State **four** factors necessitating radiometric correction in satellite image.
(4 marks)

(ii) State **four** factors affecting radiance of an object as applied in remote sensing.
(4 marks)

(b) Figure 1 shows spectral reflectance curve of three rocks. Study and use it to answer the questions that follow.

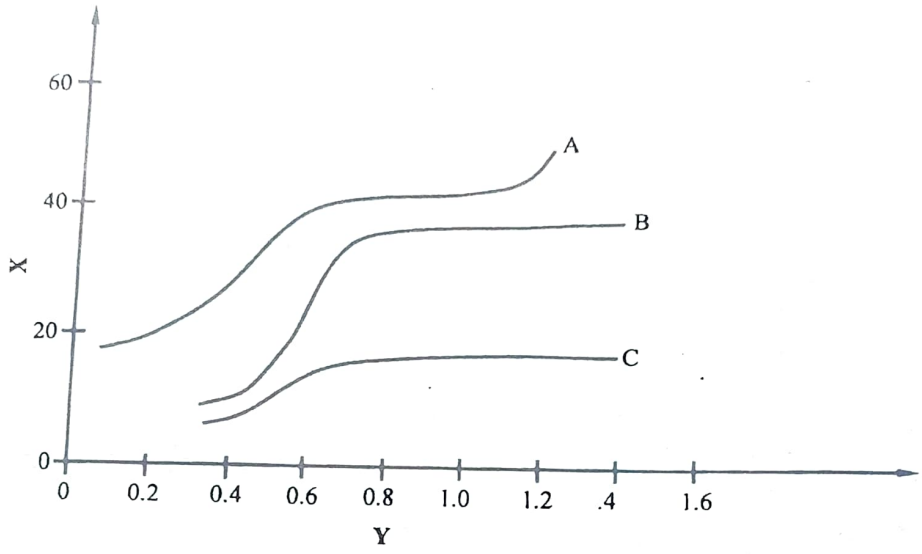

Fig. 1

(i) Name the parts of the graph represented by X and Y. (2 marks)

(ii) Identify the rocks as either arkose, basalt or limestone, giving a reason for the answer.
(6 marks)

(c) State the number of bands in the following images:

(i) panchromatic; (1 mark)
(ii) multi spectral; (2 marks)
(iii) hyper spectral. (1 mark)

7. (a) Name **two** examples of satellites in each of the following imaging system:

(i) panchromatic imaging system; (2 marks)
(ii) multi spectral imaging system; (2 marks)
(iii) hyper spectral imaging system. (2 marks)

(b) (i) State the electromagnetic radiations used in remote sensing. (3 marks)

(ii) State the wavelength range of the radiations stated in (i). (6 marks)

(c) (i) An electromagnetic wave has a frequency of 6.00×10^{14} hertz. Calculate its wavelength. (4 marks)

(ii) Identify the type of electromagnetic wave from the answer in c(i). (1 mark)

8. (a) (i) Arrange the following electromagnetic waves in descending order of their wavelengths. (4 marks)

microwave;
gamma ray;
ultra violet;
infrared.

(ii) State **one** use of each of the electromagnetic waves in (i). (4 marks)

(b) Define the following terms as used in remote sensing:

(i) orbital altitude; (1 mark)

(ii) orbital inclination angle; (1 mark)

(iii) orbital period; (1 mark)

(iv) repeat cycle; (1 mark)

(v) revisit time. (1 mark)

(c) State the RADAR equation, defining all the terms in it. (7 marks)

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