Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – December 2025

Date: 19 / 12/ 2025 **Time:** 01:00pm – 04:00pm

School: PSOE	**Program:** B.Tech. (PET)	
Course Code: PET2014	**Course Name:** Geophysical Methods for Oil and Gas Exploration	
Semester:V	**Max Marks**: 100	**Weightage**: 50%

CO - Levels	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**	**CO6**
Marks	**12**	**4**	**4**	**34**	**26**	**20**

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks. **10Q x 2M=20M**

1.	Distinguish between basalt and granite and explain what they indicate about cooling.	**2 Marks**	**L2**	**CO1**
2.	Differentiate briefly between Type I and Type III kerogen in terms of hydrocarbon potential	**2 Marks**	**L2**	**CO2**
3.	Identify the petroleum system and explain its significance	**2 Marks**	**L2**	**CO2**
4.	Describe how surface geochemical anomalies help in reducing dry-well risks during exploration.	**2 Marks**	**L2**	**CO3**
5.	Explain the benefits of geochemical exploration and how it can reduce exploration risks	**2 Marks**	**L2**	**CO3**
6.	Two masses of 10 kg and 3 kg are placed 1.5 m apart. Compute the gravitational force between them.	**2 Marks**	**L2**	**CO4**
7.	Describe two factors that cause the variation of gravitational acceleration over the earth's surface.	**2 Marks**	**L2**	**CO4**
8.	Explain how the earth gets its magnetic field.	**2 Marks**	**L2**	**CO5**
9.	Derive the expression for the magnetic field an arbitrary point if the magnetic potential at that point is known.	**2 Marks**	**L2**	**CO5**
10.	Distinguish between the Geographical meridian and the Magnetic meridian with a proper diagram.	**2 Marks**	**L2**	**CO5**

Part B

Answer the Questions. **Total Marks 80M**

11.	**a.**	A deep-water exploration well drilled along a passive continental margin retrieves a core showing thick sequences of shale interbedded with occasional basaltic lava flows. Geochemical analysis of the shale layers indicates high total organic carbon (TOC), suggesting good source rock potential. Basalt flows are linked to earlier rifting events that created widespread volcanic activity. Using this scenario, explain how volcanic activity during continental rifting and subsequent sedimentary deposition contribute to the development of a petroleum system. Describe the types of igneous and sedimentary rocks expected in this setting and evaluate their roles in hydrocarbon generation, migration, and trapping.	**10 Marks**	**L2**	**CO1**
Or					
12.	**a.**	Describe the major geological processes responsible for the formation of igneous and metamorphic rocks. In your answer: (i) Explain how partial melting, magma differentiation, and cooling history contribute to the formation of different types of igneous rocks. (ii) Describe the processes of heat, pressure, and chemically active fluids that lead to the transformation of existing rocks into metamorphic rocks and explain how different metamorphic textures are produced.	**10 Marks**	**L2**	**CO1**

13.	**a.**	Derive the expression for the gravitational potential at a point located at a distance r from a spherical body of mass M. Hence, using the derived expression, calculate the gravitational potential at a point on the line joining two-point masses $\boldsymbol{M_1} = \mathbf{5}$ kgand $\boldsymbol{M_2} = \mathbf{8}$ kg, which are separated by $\mathbf{3}$ m. The point lies $\mathbf{1}$ mfrom $\boldsymbol{M_1}$.	**10 Marks**	**L3**	**CO4**
Or					
14.	**a.**	If a planet of mass *m* revolves around a star of mass *M_s* at a distance *r*, derive the expression for the orbital velocity of the planet using Newton's law of gravitation and circular motion principles. Also, determine the gravitational acceleration acting on the planet due to the star and explain how both quantities depend on the distance *r*.	**10 Marks**	**L3**	**CO4**

15.	**a.**	*(i)* Explain in detail the working principle of a Torsion Balance Gravimeter with the help of a neat and clearly labelled diagram. Describe how gravitational gradients cause angular deflection in the instrument. *(ii)* A torsion balance instrument has two equal masses of *m = 40 g* each mounted at the ends of a horizontal rod of length *35 cm.* *The moment of inertia of the system about the suspension fibre* is I = 1.5×10^{-3} kg·m^2. The period of free oscillation is T = 60 s. Calculate:	**10 Marks [5+5]**	**L3**	**CO4**

		1. The torsional constant C of the suspension wire. 2. If the measured angular deflection is $\theta = 0.0015$ rad, determine the horizontal gravitational difference Δg acting on the two masses.			
		Or			
16.	**a.**	(i) Explain in detail the working principle of a Stable Gravimeter with a neat and well-labelled diagram. Describe how the mass–spring lever system helps detect minute variations in gravitational acceleration. (ii) A stable gravimeter consists of a mass M = 0.40 kg, a long lever arm $L_2 = 0.25$ m (mass to fulcrum), a short lever arm $L_1 = 0.015$ m (spring to fulcrum), and an effective spring constant k = 0.60 N/m. During observation, the spring extends by $\delta s = +3.00 \times 10^{-6}$ m. Determine: 1. The change in gravity δg in m/s^2. 2. Convert the result into μGal. (1 μGal = 10^{-8} m/s^2)	**10 Marks [5+5]**	**L3**	**CO4**

17.	**a.**	(i) Explain in detail the different gravity correction methods used in gravimetric surveys, clearly analyzing the conditions under which each correction (latitude, free-air, Bouguer, terrain, Eötvös, drift) must be added to or subtracted from the observed gravity value. Discuss the physical factors that influence gravity variations on the Earth. (ii) At a station located at latitude 45°, determine the latitude correction for a north–south separation of 30 km. Use the standard gravity gradient with latitude to compute the correction.	**10 Marks**	**L4**	**CO4**
		Or			
18.	**a.**	If a gravity station is located at an elevation of 600 m above the datum and the average density of the crustal rocks is 2.67 g/cm^3, Evaluate the change in gravity after applying (i) the Free-Air Correction, (ii) the Bouguer Slab Correction, and (iii) the Combined Elevation Correction. Clearly show how each correction modifies the observed gravity value and justify why each correction is required in high-elevation surveys.	**10 Marks**	**L4**	**CO4**

19.	**a.**	(i) Determine the principle of a Fluxgate Magnetometer with a neat and clean diagram. (ii) Explain how the fluxgate sensor responds to an external magnetic field and describe the role of the excitation coil, sensing coil, and core material in producing the output signal.	**10 Marks**	**L3**	**CO5**
	b.	(i) Sketch a neat and clean diagram of a proton precession magnetometer and clearly label all major components. (ii) Describe in detail the working principle of a proton magnetometer, explaining proton alignment, precession, resonance frequency, and how the magnetic field strength is computed.	**10 Marks**	**L3**	**CO5**

Or					
20.	**a.**	(i) A fluxgate magnetometer is used in a field survey to determine the vector components of the Earth's magnetic field. Sketch a neat and clean diagram of a fluxgate magnetometer and explain its working principle, including the role of the primary excitation coil and secondary sensing coils. (ii) A fluxgate instrument measures the vertical and horizontal components of the magnetic field as Z = 28,000 nT and H = 46,000 nT. Determine: 1. The total magnetic field intensity 2. The magnetic inclination in degrees	**10 Marks [5+5]**	**L3**	**CO5**
	b.	Determine and compare the magnetic properties of Diamagnetic, Paramagnetic, and Ferromagnetic substances. In your answer, clearly describe how each material behaves in an external magnetic field in terms of (i) atomic dipole alignment, (ii) direction and magnitude of magnetization, and (iii) their magnetic susceptibility. Also provide any two suitable examples for each type of material.	**10 Marks**	**L3**	**CO5**

21.	**a.**	Explain the fundamental theory behind seismic wave reflection at geological interfaces. Describe how incident P-waves interact with boundaries possessing different elastic properties. Discuss how contrast in density and velocity between two rock layers affects the amplitude and polarity of reflected waves. Provide a worked example using two layers with given impedances.	**10 Marks**	**L3**	**CO6**
	b.	A seismic reflection event is recorded at a two-way travel time (TWT) of 3.0 seconds. The average seismic velocity in the overlying sedimentary column is 2800 m/s. (a) Determine the depth to the reflector. (b) If the deeper interval velocity increases to 3400 m/s, recalculate the reflector depth and explain how velocity variation affects the interpretation of subsurface structures in seismic data.	**10 Marks**	**L3**	**CO6**
Or					
22.	**a.**	Explain the factors controlling seismic wave velocity in rocks. A shale layer has Vp = 2200 m/s and density = 2.3 g/cc; an underlying dolomite layer has Vp = 6000 m/s and density = 2.85 g/cc. (a) Compute the acoustic impedance of both layers. (b) Compute the reflection coefficient at the interface and interpret whether the boundary will produce a strong or weak reflection based on the impedance contrast.	**10 Marks**	**L3**	**CO6**
	b.	Illustrate shot gathers and CMP gathers with neat sketches. Explain how Normal Moveout (NMO) correction transforms shot gathers into CMP gathers and enhances the signal-to-noise ratio. Discuss how velocity analysis is performed using CMP gathers.	**10 Marks**	**L3**	**CO6**