

7. (a) Explain Slater Type Orbitals (STOs) and Gaussian Type orbitals (GTOs).
- (b) How does the basis set selection effect the Gaussian calculations. Discuss the types of basis set.

**UNIT-IV**

[10]

8. Discuss various theories for origin of life.
9. (a) Which factors effect the stability of Galactic Habitable Zone ?
- (b) What are the various detection techniques of Exoplanets ? Discuss Transit method and Gravitational microlensing in detail.

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## Question Paper Code : 5650

**M.A./M.Sc. (Sem.-IV) Examination, 2018**

**MATHS**

**[ Thirteenth Paper ]**

**( Optional Paper : Astrobiology )**

**Time : Three Hours]**

**[Maximum Marks : 70**

**Note :** Attempt **five** questions in all choosing **one** question from each unit. Question **No.1** is **compulsory**.

1. Attempt all the parts : [3x10=30]
- (a) What do you understand by Interstellar medium and Interstellar molecules ?
- (b) What makes Enceladus a very interesting target in the search for extraterrestrial life ?
- (c) Write short note on Rare Earth Hypothesis.
- (d) What do you understand by single point energy and electronic transition ?
- (e) Explain the various tools to determine the age of the Earth ?

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[P.T.O.]

- (f) Show that range of habitable zone of earth lies between 0.95 AU to 1.37 AU.
- (g) Explain the Independence of electrons and electron correlation approximations in short.
- (h) What do you understand by chemical evolution of life and cognogency ?
- (i) Explain short period an long period comets with two examples.
- (j) Explain the theory that accounts for Jupiter's internal energy source.

**UNIT-I** [10]

2. Answer the following in brief :

- (a) What are the various evidences of Water on Mars and where did all that water go ?
- (b) Discuss the various Space Missions of Mars and what are their important findings ?

3. Explain the following in brief :

- (a) What are the main reasons that lead us to explore life on Europa ?
- (b) Write short notes on Mars Exploration Rovers Spirit and Opportunity.

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- (c) Explain the relevance of Roche limit with appropriate diagram.
- (d) Why comets are considered as the source of biological material ?

**UNIT-II** [10]

- 4. (a) Explain the various techniques to identify the interstellar molecules spectroscopically.
- (b) Why is the study of Interstellar Medium important?
- 5. (a) Explain various parts of the comets in brief. Where did the comets come from ?
- (b) What is the eventually fate of most short period and long period comets ?

**UNIT-III** [10]

- 6. If any system consisting of electron moving under the influence of an external potential  $V_{\text{ext}}(r)$  and having electron density  $n(r)$  , then show that:
  - (a) The total energy of a system is a unique functional of  $n(r)$ .
  - (b)  $E_v[n'(r)] > E_v[n(r)]$  : v-representable.

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