Answer any five from the following six questions.

1. What is an ontology? Discuss with examples the steps of designing a domain ontology. [20]

2. (a) Discuss the relationships between OWL 2 Full and OWL 2 DL. [10]
   (b) Discuss critically the salient features of OWL 2.0. [10]

3. (a) Why logic is important for data and knowledge representation? Critically discuss the merits and demerits of logic for data and knowledge representation. [3+7]
   (b) Assume the following RDF document:

> <http://example.org/#john> <http://www.w3.org/2001/vcard-rdf/3.0#FN> "John Smith"
> <http://example.org/#john> <http://www.w3.org/2001/vcard-rdf/3.0#N> : X1
> :X1 <http://www.w3.org/2001/vcard-rdf/3.0#Given> "John"
> :X1 <http://www.w3.org/2001/vcard-rdf/3.0#Family> "Smith"
> <http://example.org/#john> <http://example.org/#hasAge> "32"
> <http://example.org/#john><http://example.org/#marriedTo> <http://example.org/#mary>
> <http://example.org/#mary> <http://www.w3.org/2001/vcard-rdf/3.0#FN> "Mary Smith"
> <http://example.org/#mary> <http://www.w3.org/2001/vcard-rdf/3.0#N> : X2
> :X2 <http://www.w3.org/2001/vcard-rdf/3.0#Given> "Mary"
> :X2 <http://www.w3.org/2001/vcard-rdf/3.0#Family> "Smith"
> <http://example.org/#mary> <http://example.org/#hasAge> "29"

Extend the above graph by adding the RDFS class information for the persons and marriage. [10]

4. (a) Briefly describe RDF with an example. Critically evaluate the significance of RDFS in data and knowledge representation. [5+5]
   (b) Given the following RDF triples (expressed in Turtle format)

> @prefix owl: <http://www.w3.org/2002/07/owl#> .
> @prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
> @prefix xml: <http://www.w3.org/XML/1998/namespace> .
> @prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
> @prefix foaf: <http://xmlns.com/foaf/0.1/> .
> @prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
> @prefix   : < http://www.semanticweb.org/ontologies/people#> .

```
:Anne rdf:type owl:NamedIndividual ,
        :Person ;
    :biologicalMotherOf :John ;
    :isCitizenOf :France ;
    :livesIn :NewYork ,
        :Paris ;
    :age 62 ;
    :name "Anne Toulet"^^xsd:string ;
    foaf:fName "Anne"^^xsd:string ;
    foaf:lName "Toulet"^^xsd:string .

:John rdf:type owl:NamedIndividual ,
        :Person ;
    :hasParent :Anne ;
    :isCitizenOf :USA ;
    :livesIn :NewYork ;
    :age 32 ;
    :emailId "john@gmail.com"^^xsd:string ;
    :name "John G."^^xsd:string ;
    foaf:fName "John"^^xsd:string ;
    foaf:lName "Gabriyal"^^xsd:string .

:PCM rdf:type owl:NamedIndividual ,
        :Person ;
    :isCitizenOf :India ;
    :livesIn :Kolkata ,
        :NewYork ;
    :emailId "pcm@gmail.com"^^xsd:string ;
    :name "PC Mahalanobis"^^xsd:string ;
    foaf:fName "Prashanta Chandra"^^xsd:string ;
    foaf:lName "Mahalanobis"^^xsd:string .
```

(i) write a SPARQL query that returns the foaf first names of the persons, and their email ids (treat email id optional). [5]

(ii) write a SPARQL query that counts the number of places Anne lives in. [5]

5. (a) What is Description Logics (DL)? Discuss why description logics itself cannot be considered as an ontology language? [2+8]

(b) What is a reasoner? Discuss with examples the following three reasoning tasks of a reasoner: Consistency, Classification, and Class membership. [10]

6. Answer *any four* from the following. [4*5=20]
   (a) Briefly, discuss the SPARQL "select" form.
   (b) Briefly, discuss the RDF "blank node."
   (c) Briefly, discuss the "open world assumption vs. closed world assumption."
   (d) Briefly, describe "RDF Collections."
   (e) Briefly, describe "SKOS."