DM Assignment 1, Aug 8, 14.00 - Solutions.

For the following, write the most appropriate logical notation. That is, present FOL if possible, otherwise, ZOL. For FOL, clearly mention UOD, predicates used and their definitions. For all, you should use logical operators only as it is a logical expression. You should not use, cardinality operator, relational operator and other non logical operators.

1. Be silent. Let your success make noise.
   This is an imperative sentence and hence, not a proposition.

2. If you want to be successful in life, then read, read more, read even more.
   `Approach 1:` The second half of the sentence is imperative if the statement is seen as atomic one, and hence the logical expression is $P$ which denotes 'you want to be successful in life'
   `Approach 2:` Since it is a conditional statement, the scope of the subject 'you' is active throughout the statement. Then, $P \rightarrow (Q \wedge R \wedge S)$

3. Life is like a music. Some low notes, some high notes but always a good music.
   $P \wedge \exists x(low(x) \wedge high(x) \wedge goodmusic(x))$

4. Life is full of challenging problems. Any challenging problem must be mapped to some known problem in some way to obtain some solution, if not the best.
   `Approach 1:` $P \wedge \forall x(challengeproblem(x) \rightarrow \exists y(knownproblem(y) \wedge \exists z(solutionway(z) \wedge \exists w(solution(w) \wedge map(x,y,z,w) \wedge \neg bestsolution(w)))))$

   `Approach 2:` $P \wedge (\exists w(solution(w) \wedge \neg bestsolution(w) \rightarrow \forall x(challengeproblem(x) \rightarrow \exists y(knownproblem(y) \wedge \exists z(solutionway(z) \wedge map(x,y,z,w))))))$

5. Why are some students skipping my classes? Either not interested in acdemics or my classes are not so interesting. This is a serious problem that any teacher must look into. Framing strict rules do not solve this problem. Some IITs and IIITs have smart attendance system. For any smart system, there exists a loop hole which any student of IIT or IIIT can exploit.
   The first statement is an interrogative statement and hence, not a proposition.
   $\exists x(students(x) \wedge (\neg notintacademics(x) \oplus \neg classint(x)) \wedge \forall y(teacher(y) \rightarrow lookintoproblem(x,y) \wedge \neg(rulesolve(x))) \wedge \exists x(IIT(x) \wedge smartattendance(x)) \wedge \exists x(IIIT(x) \wedge smartattendance(x)) \wedge \forall y(smartattendance(y) \rightarrow \exists z(loophole(y,z) \wedge \forall w(student(w) \rightarrow canexploit(w,z))))$

6. Any CBSE student appears for JEE Main or JEE Advanced. Some students clear both the examinations, some clear neither and the rest clear just JEE main. There are students who cleared JEE main got admit in both NIT and IIIT. There are at most three students who got admit in both NIT and IIIT. Therefore, some students are studying in deemed universities.
   $[\forall x((student(x) \wedge cbse(x)) \rightarrow (appearjeemain(x) \vee appearjeeadv(x))) \wedge \exists x(student(x) \wedge (clearjeemain(x) \wedge clearjeeadv(x)) \wedge \exists x(\neg clearjeemain(x) \wedge \neg clearjeeadv(x) \wedge \forall z(z \neq x \rightarrow clearjeemain(z)) \wedge \exists w(student(w) \wedge clearjeemain(w) \wedge \exists p \exists q(clearjeemain(p) \wedge nit(p) \wedge clearjeemain(q) \wedge iiit(q) \wedge admit(w,p) \wedge admit(w,q))) \wedge \neg \exists p \exists q \exists r \exists s(distinct(p,q,r,s) \wedge admit(p,nit) \wedge admit(q,nit) \wedge admit(r,nit) \wedge admit(s,nit) \wedge admit(p,iiit) \wedge admit(q,iiit) \wedge admit(r,iiit) \wedge admit(s,iiit))] \rightarrow \exists x(student(x) \wedge studydeemed(x))$.

7. Despite his hard work, he could not clear JEE main. Nevertheless, he made it to the top private university. Not all private universities are good. Some private universities are as good as premier institutes.

Since private universities charge more tutition fees unless women candidates, not many prefer these universities.
$(P \wedge Q) \wedge R \wedge \neg\forall x(privateuniv(x) \rightarrow good(x)) \wedge \exists y(privateuniv(y) \wedge asgoodas(y, premierinsti)) \wedge \forall z((student(z) \wedge \neg women(z)) \rightarrow \forall w(privateuniv(w) \rightarrow (moretuitionfee(z, w) \wedge \neg prefer(z, w))))$.

8. I like some one, however he does not like me. Nobody likes themselves. Who is a personality ? A personality is one known by all and liked by all, and the personality need not know or like others.
$\exists x(like(me, x) \wedge \neg like(x, me)) \wedge \forall y(\neg like(y, y)) \wedge \forall z(personality(z) \rightarrow (\forall y(person(y) \rightarrow (known(y, z) \wedge like(y, z) \wedge (((known(z, y) \oplus \neg known(z, y)) \vee (like(z, y) \oplus \neg like(z, y)))))))$.

9. If you work at least 14 hours a day then you will go to bed with satisfication. Further, you will wake up with determination. Negate the above argument. For the conditional statement, write the inverse, converse and contrapositive.
$(P \rightarrow Q) \wedge R$. Negation in FOL: $\neg((P \rightarrow Q) \wedge R) \equiv (P \wedge \neg Q) \vee \neg R$. Negation in English: you work at least 14 hours a day and you will not go to bed with satisfaction, or you will not wake up with determination. NOTE: the placement of comma is important while we write statement in English. Inverse: if you work less than 14 hours a day then you will not go to bed with satisfaction. Converse: If you go to bed with satisfaction then you had worked for at least 14 hours a day. Contrapositive: If you do not go to bed with satisfaction then you had not worked at least 14 hours a day.

10. For any set, empty set is a subset of itself. A necessary condition for a set to be infinite is that the set is not countable. All sets are either finite or infinite. A mapping to natural numbers is sufficient to show that sets are infinite.
$\forall x((set(x) \wedge empty(x)) \rightarrow subset(x, x)) \wedge \forall x((set(x) \wedge infinite(x)) \rightarrow \neg countable(x)) \wedge \forall x(set(x) \rightarrow (finite(x) \oplus infinite(x)) \wedge \forall x((set(x) \wedge mapnatural(x)) \rightarrow infinite(x))$.