Question 1:

1)

Given relation R(L,M,N,O,P,Q);

functional dependencies F = {LNO→M, MN→LOP, N→ O, OP→LN}. Can we infer NP →LM

We break this down as NP→L and NP→M

From functional dependencies

N→O(NP→OP FROM augmentation rule)

OP→L

Therefore NP→L is true.

NP→L from above

NP→N from trivial rule

NP→P from trivial rule

N→O

From above

NP→LNO

LNO→M

NP→M it is true

Both are true it satisfies NP→LM.

2) NQ→LO

Breakdown NQ→L AND NQ→O Check if NQ→L:

N→O

OP→L

IN THE GIVEN F

L CAN BE DERIVED USING MN→L

OP→L

SO,L cannot be derived using NQ Therefore NQ→L is not possible NQ→LO is not possible

Question2:

A)

As per the edge diagram we don't have incoming edges for B and E.

So it could be possible for candidate key with combination of other attributes. Now add each attribute to find closure:

(ABE)+,(CBE)+,(DBE)+

closure of (ABE)+ is {A,B,E,D,C}

Therefore it is candidate key;

closure of (CBE)+ is {C,B,E,A,D}

Therefore it is candidate key;

closure of (DBE)+ is {D,B,E,A,C}

Therefore it is candidate key;

All candidate keys are (ABE)+,(CBE)+,(DBE)+

B)

As per the edge diagram we don't have incoming edges for A,B and E.

So it could be possible for candidate key with combination of other attributes. Now add each attribute to find closure:

(ABCE)+,(ABDE)+,(ABEF)+

closure of (ABCE)+ is {A,B,C,E} Therefore it is not a candidate key;

closure of (ABDE)+ is {A,B,E,D} Therefore it is not a candidate key; closure of (ABEF)+ is {A,B,E,F,C,D} Therefore it is candidate key;

THEREFORE CANDIDATE KEY IS (ABEF)+;

(ABEF)+ ITSELF IS A SUPERKEY;

Add two attribute C,D to (ABEF)+

(ABCEF)+ is a super key;

(ABDEF)+ is a super key;

(ABCDEF)+ is a super key;

(ABEF)+, (ABCEF)+, (ABDEF)+, (ABCDEF)+ are superkey's

Question3:

Minimal cover of F
Every dependency in F must have a single attribute on the right hand side.
$Z \rightarrow UT \Rightarrow Z \rightarrow U, Z \rightarrow T$
Remove all extraneous attributes such as $P \rightarrow Y$ and $PQ \rightarrow Y$ then Q is extraneous attribute
So, $X \rightarrow Z$ and $XY \rightarrow Z$ then Y is extraneous attribute so remove it $\Rightarrow X \rightarrow Y$

So, In given Functional dependencies: -

1. Convert Right hand side attribute into single
   $Z \rightarrow U$, $Z \rightarrow T$, $ZW \rightarrow X$, $ZW \rightarrow Y$
2. Remove extraneous attribute: $X \rightarrow Z$, $XY \rightarrow Z$
   $Z \rightarrow T$, $ZU \rightarrow T \Rightarrow Z \rightarrow T$
3. Remove redundant Functional dependencies :
   $X \rightarrow Z$, $Z \rightarrow T$

So, minimal cover of given F is :-
$X \rightarrow Z$, $Z \rightarrow U$, $Z \rightarrow T$, $ZW \rightarrow X$, $ZW \rightarrow Y$, $WT \rightarrow Z$

Question4:

Equivalent conditions are FD1 covers FD2 and FD2 covers FD1.

Equivalent with FD2: Check if FD2 covers FD1:

Part of relations in FD1: BC→D, AB→C, C→A, D→E, BE→C, D→G, are already in FD2, so we do not need to find them in FD2.

The rest of relations in FD1: ACD→ACDBEG so, ACD→B.

CG→CGADBEG so,CG→B, CG→D.

CE→CEA so,CE→A,but CE→G in FD1 is not covered by FD2.

Finally, FD1 and FD2 are not equivalent.

Equivalent conditions are FD1 covers FD3 and FD3 covers FD1. Equivalent with FD3: Check if FD3 covers FD1:

Part of relations in FD1: BC→D, CG→D, AB→C, C→A, D→E, BE→C, D→G, CE→G, are already in FD3, so we do not need to find them in FD3.

The rest of relations in FD1: ACD→ACDGEB so,ACD→B. CG→CGDEAB so,CG→B.

CE→CEGADB so,CE→A.

As a result, FD3 covers FD1.

Check if FD1 covers FD3:

Similarly, AB→C, C→A, D→G, BE→C, CG→D, CE→G,BC→D, D→E are not in FD1. CD→CDAEGB so,CD→B.

As a result, FD1 covers FD3.

Finally, FD1 and FD3 are equivalent.