Pbms:

Construct truth table:

1) $P \wedge \neg P$

Soln

P	$\neg P$	$P \wedge \neg P$
T	F	F
F	T	F

2) $P \vee \neg P$

P	$\neg P$	$P \vee \neg P$
T	F	T
F	T	T

3) i) $P \wedge P$ (ii) $P \vee P$

P	P	$P \wedge P$	$P \vee P$
T	T	T	T
F	F	F	F

4) $\neg\neg P$

P	$\neg P$	$\neg\neg P$
T	F	T
F	T	F

5) $\neg P \wedge Q$

(there are 2 variables
$\therefore 2^2 = 4$ elements)

P	Q	$\neg P$	$\neg P \wedge Q$
T	T	F	F
T	F	F	F
F	T	T	T
F	F	T	F

6) $P \vee \neg Q$

P	Q	$\neg Q$	$P \vee \neg Q$
T	T	F	T
T	F	T	T
F	T	F	F
F	F	T	T

7) $P \wedge (P \vee Q)$

P	Q	$P \vee Q$	$P \wedge (P \vee Q)$
T	T	T	T
T	F	T	T
F	T	T	F
F	F	F	F

8) $(P \vee Q) \vee \neg P$

9) i) $\neg(\neg P \vee \neg Q)$ ii) $\neg(\neg P \wedge \neg Q)$

P	Q	$\neg P$	$\neg Q$	$\neg P \vee \neg Q$	$\neg(\neg P \vee \neg Q)$
T	T	F	F	F	T
T	F	F	T	T	F
F	T	T	F	T	F
F	F	T	T	T	F

10) $(P \rightarrow Q) \wedge (Q \rightarrow P)$

P	Q	$P \rightarrow Q$	$Q \rightarrow P$	$(P \rightarrow Q) \wedge (Q \rightarrow P)$
T	T	T	T	T
T	F	F	T	F
F	T	T	F	F
F	F	T	T	T

11) $(Q \wedge (P \rightarrow Q)) \rightarrow P$

P	Q	$P \to Q$	$Q \wedge (P \to Q)$	$(Q \wedge (P \to Q)) \to P$
T	T	T	T	T
T	F	F	F	T
F	T	T	F	F
F	F	T	F	T

12) $\neg(P \wedge Q) \iff (\neg P \vee \neg Q)$

P	Q	(P ∧ Q)	¬(P ∧ Q)	¬P	¬Q	¬P ∨ ¬Q	¬(P ∧ Q) <=> ¬P ∨ ¬Q
T	T	T	F	F	F	F	T
T	F	F	T	F	T	T	T
F	T	F	T	T	F	T	T
F	F	F	T	T	T	T	T

13) $(P \rightarrow Q) \rightarrow P$

14) $(P \rightarrow Q) \wedge (Q \rightarrow P)$

15) $(P \vee \neg Q) \rightarrow Q$

16) $(P \rightarrow Q) \Leftrightarrow (\neg P \vee Q)$

P	Q	$P \rightarrow Q$	$\neg P$	$\neg P \vee Q$	$(P \rightarrow Q) \Leftrightarrow (\neg P \vee Q)$
T	T	T	F	T	T
T	F	F	F	F	T
F	T	T	T	T	T
F	F	T	T	T	T

17) $(P \oplus Q) \rightarrow (P \wedge Q)$

P	Q	$P \oplus Q$	$P \wedge Q$	$(P \oplus Q) \rightarrow (P \wedge Q)$
T	T	F	T	T
T	F	T	F	F
F	T	T	F	F
F	F	F	F	T

18) $\neg(P \vee Q) \wedge (P \vee R)$

(3 variables $\therefore 2^3 = 8$ elements)

P	Q	R	P∨Q	¬(P∨Q)	(P∨R)	¬(P∨Q) ∧ (P∨R)
T	T	T	T	F	T	F
T	T	F	T	F	T	F
T	F	T	T	F	T	F
T	F	F	T	F	T	F
F	T	T	T	F	T	F
F	T	F	T	F	F	F
F	F	T	F	T	T	T
F	F	F	F	T	F	F

Other connectives:

* NAND ($\uparrow$) ; NOT of AND

P NAND Q = $P \uparrow Q = \neg(P \wedge Q)$

(ie) $P \uparrow Q \iff \neg(P \wedge Q)$ where $\iff$ denotes logical equivalence

Truth table

P	Q	$P \uparrow Q$
T	T	F
T	F	T
F	T	T
F	F	T

* NOR ($\downarrow$) NOT of OR

P NOR Q = $P \downarrow Q = \neg(P \vee Q)$

i.e) $P \downarrow Q \Leftrightarrow \neg(P \vee Q)$

Truth table

P	Q	$P \downarrow Q$
T	T	F
T	F	F
F	T	F
F	F	T

19) Construct truth table of:

$\neg(P \uparrow Q) \Longleftrightarrow \neg P \downarrow \neg Q$

P	Q	$P \uparrow Q$	$\neg(P \uparrow Q)$	$\neg P$	$\neg Q$	$\neg P \downarrow \neg Q$	$\neg(P \uparrow Q) \Longleftrightarrow \neg P \downarrow \neg Q$
T	T	F	T	F	F	T	T
T	F	T	F	F	T	F	T
F	T	T	F	T	F	F	T
F	F	T	F	T	T	F	T

20) $\neg(P \downarrow Q) \longleftrightarrow \neg P \uparrow \neg Q$

pbm:

P : I will study discrete maths

Q : I will read books

R : I am in a good mood.

write the following sentences using logical connectives

i) If I am not in good mood then I will read books.

Ans : $\neg R \rightarrow Q$

ii) I will not read books and I will study discrete maths

Ans : $\neg Q \wedge P$

iii) If I am not studying discrete maths then I am not in good mood.

$\neg P \rightarrow \neg R$

Pbm: Write converse, contrapositive, Inverse of:

If it is raining then I will take an umbrella.