

Q.1

The production rules are:

$S \rightarrow aS$

$S \rightarrow ab$

The rule $S \rightarrow aS$ can be applied any number of times (including zero times) that will generate the form a^n where $n \geq 0$.

Then we can apply the rule $S \rightarrow ba$ as a suffix to any number of strings generated in the previous step.

Therefore, any string generated by this CFG will be of the form a^*ba .

Q.2

The CFGs for the language with all words that do not have the substring 'ab':

$S \rightarrow bS \mid aA$

$A \rightarrow aA \mid \epsilon$

Q.3

In CFG 1, it cannot generate 'abba' because the base word close to 'abba' that this CFG can generate is 'aabbab'. In CFG 3, it cannot generate 'abba' because the base word close to 'abba' that this CFG can generate is 'aabba'. In CFG 4, it cannot generate 'abba' because the base word close to 'abba' that this CFG can generate is 'aabba'.

CFG 2 can generate the word 'abba' and the syntax tree is:

```

      S
     /\
    a S
      /\
     b S
      /\
     b S
      |
      a
```

CFG 5 can generate the word 'abba' and the syntax tree is:

```

    S
  /\
 a B
  /\
 b S
  /\
 b A
  |
  a

```

Q.4

Converted to CNF:

$S \rightarrow AX \mid YB$

$X \rightarrow MN \mid a$

$Y \rightarrow b \mid BY \mid B$

$Z \rightarrow a$

$A \rightarrow a$

$B \rightarrow b$

$M \rightarrow ZX$

$N \rightarrow ZY$

Q.5

