Normalize the relation R that has the attributes: a, f, g, h, j, k, l, m, n, p, q, r, s, t, v, w, x, y, z, up to 3NF based on the following functional dependencies:

$$p \rightarrow a, f, g, m, n$$

$$f \rightarrow m, n$$

$$h \rightarrow j, k, l$$

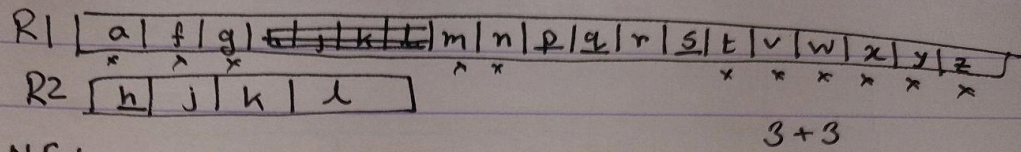$$k \rightarrow l$$

$$s \rightarrow t$$

$$p, q, s \rightarrow r$$

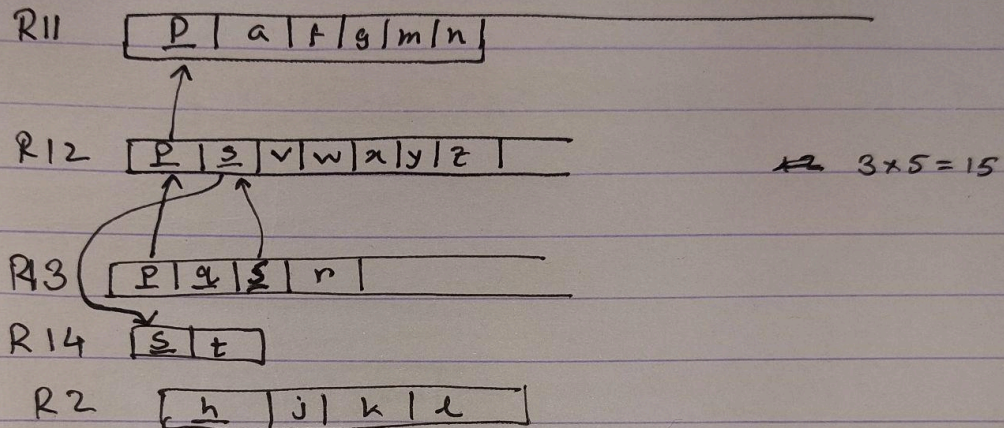$$a, t \rightarrow v, w, x, y, z$$

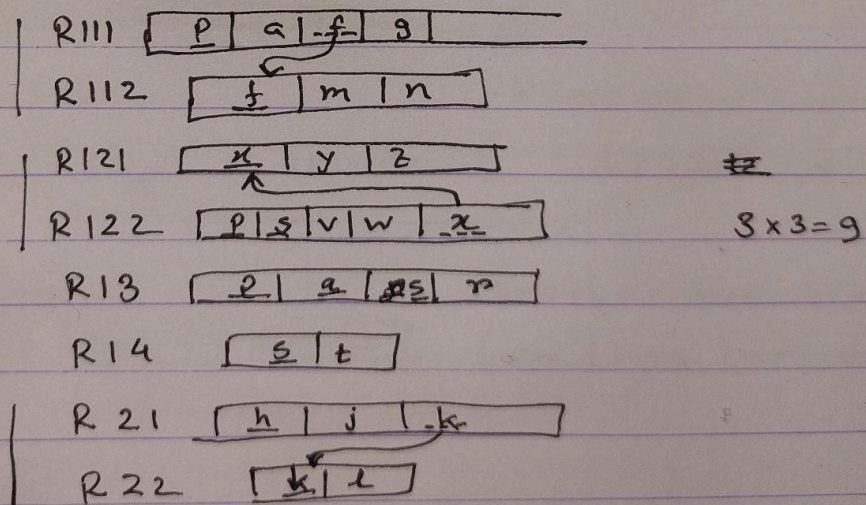$$x \rightarrow y, z$$

Question - 3   Solution

1NF :-

R1 | a | f | g | ~~h~~ | ~~j~~ | k | ~~l~~ | m | n | p | q | r | s | t | v | w | x | y | z |

R2 | h | j | k | l |

3 + 3

2NF :

R11 | p | a | f | g | m | n |

R12 | p | s | v | w | x | y | z |

R2   3×5 = 15

R3 | p | q | s | r |

R14 | s | t |

R2 | h | j | k | l |

3NF :

R111 | p | a | f | g |

R112 | f | m | n |

R121 | x | y | z |

R122 | p | s | v | w | x |

R2   3×3 = 9

R13 | p | q | s | r |

R14 | s | t |

R21 | h | j | k |

R22 | k | l |

Normalize the relation R that has the attributes: a, b, d, e, f, g, h, j, k, l, s, t, w, x up to BCNF based on the following functional dependencies:

b, e → a, d, g, h

a   → f, g, h

b   → j, l

k   → e, s, t

e   → w

w   → x

1NF:

R | a | b | d | e | f | g | h | j | k | l | s | t | w | x |

2NF:

R1 | b | j | l |

R2 | k | e | s | t | w | x |

R3 | b | k | a | d | g | h | f |

R2 is already in 2NF

3NF:

R1 already in 3NF

R1 | b | j | l |

R21 | w | x | R22 | e | w |

R23 | k | e | s | t |

R31 | a | f | g | h | R32 | b | k | a | d |

BCNF:

All relations are in BCNF

Normalize the relation R that has the attributes: a, b, c, d, e, f, g, h, j, k, p, s, t, w, y, z up to BCNF based on the following functional dependencies:

$d \rightarrow$ a, b, c, e, f

$g \rightarrow$ h, j

$j \rightarrow$ k

$p \rightarrow$ a, b, c, d, e, f

p, t $\rightarrow$ z, y

t $\rightarrow$ s, w

z $\rightarrow$ t

Below six functional dependencies are given. Normalize the table T using the functional dependencies to get rid of all possible anomalies upto BCNF.

T (a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, w, x, y, z)

Functional Dependencies:

p → d, e, f, g, h, j, k, l, m, n, o, q

q → l, m, n, o

e → f, g, h, j

p, x → a, b, c, i, w, r, y, z

w → c, r, y, z

i → x

1NF:

T | a | b | c | d | e | f | g | h | i | j | k | l | m | n | o | p | q | r | w | x | y | z |

2NF:

T1 | p | d | e | f | g | h | j | k | l | m | n | o | q |

T2 | i | x |

T3 | p | i | a | b | c | w | r | y | z |

3NF:

T11 | q | l | m | n | o | T12 | e | f | g | h | j |

T13 | p | d | e | k | q |

T2 already in 3NF. T2 | i | x |

T31 | w | c | r | y | z |

T32 | p | i | a | b | w |

Below six functional dependencies are given. Normalize the table T using the functional dependencies to get rid of all possible anomalies.

T (a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z)

a -> b,c,d,e,f,g,m,n,o

e -> h,i,j,k,l

x -> y,z

t -> r,s,u,v,w,x,y,z

a,t -> p,q

k ->l

1NF:

T	**a**	**t**	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	b	u	v	w	x	y	z

2NF:

T11

a	b	c	d	e	f	g	m	n	o	h	i	j	k	l

T13

a	**t**	p	q

T12

t	r	s	u	v	w	x	y	z

3NF:

T13

a	**t**	p	q

T112

e	h	i	j	k

T113

k	l

T111

a	b	c	d	e	f	g	m	n	o

T121

t	r	s	u	v	w	x

T122

x	y	z

T13 was already in 3NF.

Below six functional dependencies are given. Normalize the table T using the functional dependencies to get rid of all possible anomalies.

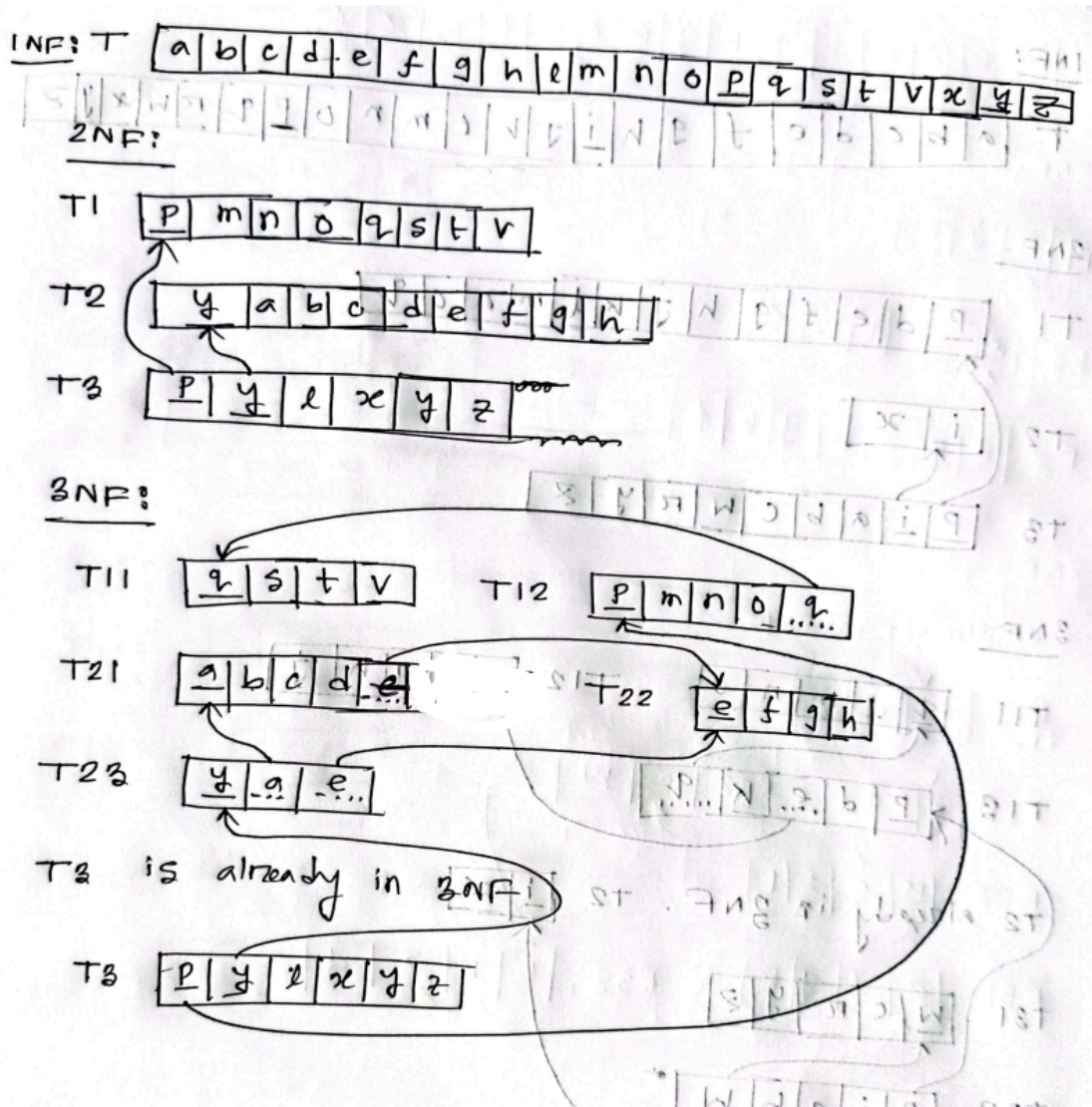T (a, b, c, d, e, f, g, h, l, m, n, o, p, q, s, t, v, x, y, z)

a->b, c, d, e, f, g

e->f, g, h

p->m, n, o, q

q->s, t, v

a, p->l, x, y, z

y->a

Below five functional dependencies are given. Normalize the table T using the functional dependencies to get rid of all possible anomalies.   [20]

T (a, b, c, d, e, f, g, h, i, j, k, l, m, n, t, x, y, z)

Five Functional Dependencies are given below:
i. a—-> c, d, k, l, m, n
ii. k—->l, m, n, b
iii. e—-> f, g, h, i, j
iv. a, e —-> t, x, y, z
v. t—->e
vi. x—->y,z

1NF:

T | a | b | c | d | e | f | g | h | i | j | k | l | m | n | t | x | y | z

2NF:

T1 | a | c | d | k | l | m | n | b   T2 | t | e | f | g | h | i | j

T3 | a | t | x | y | z

3NF:

T11 | k | l | m | n | b   T12 | a | c | d | k..

T21 | e | f | g | h | i | j   T22 | t | e.

T31 | x | y | z

T32 | a | t | x..
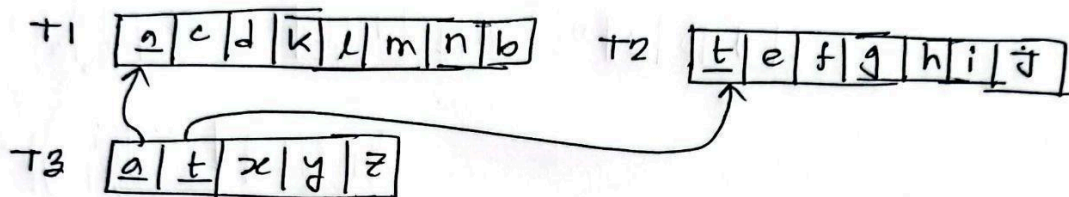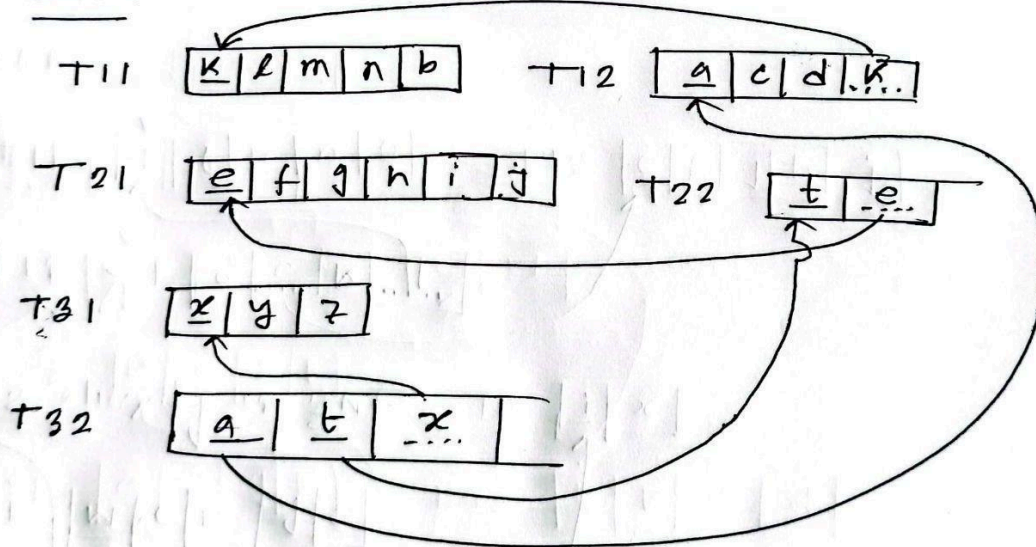
Consider the relation R (a,b,c,d,e,f,g,h,i,k,l,m,n,o,p,q,r,s,t,x,y,z)

Normalise the table R using the functional dependencies given below to get rid of all possible anomalies.

m $\longrightarrow$ a,b,c,d,e
o,m $\longrightarrow$ f,g,h,i,k,l,x
n,t $\longrightarrow$ r,s
n $\longrightarrow$ p,q
x $\longrightarrow$ y,z

1NF:

R1 | a | b | c | d | e | f | g | h | i | u | l | _m_ | _o_ | x | y | z

R2 | _n_ | _t_ | r | s | P | q

2NF:

R11 | _m_ | a | b | c | d | e

R12 | _m_ | _o_ | f | g | h | i | u | l | x | y | z

R21 | _n_ | P | q

R22 | _n_ | _t_ | r | s

3NF:

R21, R22
R11 ↑ already in 3NF

R11 | _m_ | a | c | d | e

R121 | _x_ | y | z

R122 | _m_ | _o_ | f | g | h | i | k | l | _x_

R21 | _n_ | P | q

R22 | _n_ | _t_ | r | s

The relation given below lists customer/car hire data. Each customer may hire cars from various outlets located in different places. A car is registered at a particular outlet and can be hired out to a customer on a given date. The car has maker (e.g. Ford) and model (e.g. Mustang). **Your task is to illustrate the process of normalization by converting the relation up to BCNF. Identify the primary and foreign keys in your relations.**

CarRegistrationNo	Model	Maker	CustomerID	CustomerName	HireDate	OutletNo.	Location

Normalization   (Autumn 2018)

Case 01: A human resource management (HRM) department wishes to create a database to monitor its employees. The company is divided into a number of departments, and employees are assigned to one department. Two types of workers have been identified: shop floor workers and office workers. Each shop floor worker has a specific skill and performs a specific task. Office workers, on the other hand, are identified by their role and the department to which they belong.

The department has a designated Manager who has overall responsibility for the department and the employees in the department. However, to help manage the department, a number of employees are nominated to supervise groups of staff. When a new employee joins the company, information on previous work history and qualifications is required. On a regular basis, each employee is required to undergo a review, which is normally carried out by the Manager, but may be delegated to a nominated representative.

The company has defined a number of position types, such as Manager, Business Analyst, Salesperson, Secretary, and each type has a number of grades associated with it, which for most non-senior positions determines the employee's salary. At senior level, salary is negotiable. Posts are allocated to a department depending on its workload. For example, a department may be allocated two new Business Analyst posts. A post will be filled by one employee, although over time, employees will fill a number of different posts.

Create an EER diagram for the above scenario and indicate the cardinality of relationships and the nature of the associations (mandatory or optional). You should allocate adequate attributes to the entities of interest, and specify the identifiers.

Case 02: A relation for keeping student reports is specified below by its schema. The primary key/s is underlined:

Report (<u>studentId</u>, studentName, campus, <u>moduleId</u>, moduleTitle, instructorName, instructor-Location, grade)

- **Question 03(a):** Determine and state the functional dependencies that hold in the above relation.   [04 marks]

- **Question 03(b):** Generate 2NF (second normal form) and then 3NF (third normal form) relations from the schema. Indicate clearly the primary keys and foreign keys where appropriate.   [06 marks]