



NATIONAL INSTITUTE OF TECHNOLOGY
WARANGAL

Database design for tracking various aspects of ISRO Missions



Overview

We all know that the Indian Space Research Organization (ISRO) creates, builds and launches rockets and satellites that carry the complex spacecraft that form interconnected systems not just of India but those of other countries too.

It was established in 1962 by India's first Prime Minister Pt. Jawaharlal Nehru and scientist Vikram Sarabhai, considered amongst the founding fathers of the Indian space program.

ISRO, by successfully exhibiting its distinct and cost-effective technologies, quickly gained place among the predominant space organizations in the world.



The main aim of this project is to track the various missions that have been conducted by the ISRO in addition to storing data from the very conception of a mission all the way to its testing.

Details pertaining to the rockets and satellites that are involved as well as their specifications are indicated thus contributing to an extensive analysis of the missions at hand.



Goals

- Exhibiting each feature involved in every ISRO mission in an efficient manner so as to be able to access, manage and view the system conveniently.
- Recognizing the unique capabilities, expertise and techniques available at different ISRO Centers.
- Providing a convenient way to link similar attributes like IDs through the use of various primary and foreign keys.
- Ensure that there are no anomalies present in the database by converting the relation to a normalized form.



ER Model

Old Entity-Relationship Model:

One of the main drawbacks we saw with the model was the irrelevance and the redundancy that the addition of the various specifications' relationships caused. The manufacturer information in particular was being repeated again and again in different records leading to updation of anomalies.

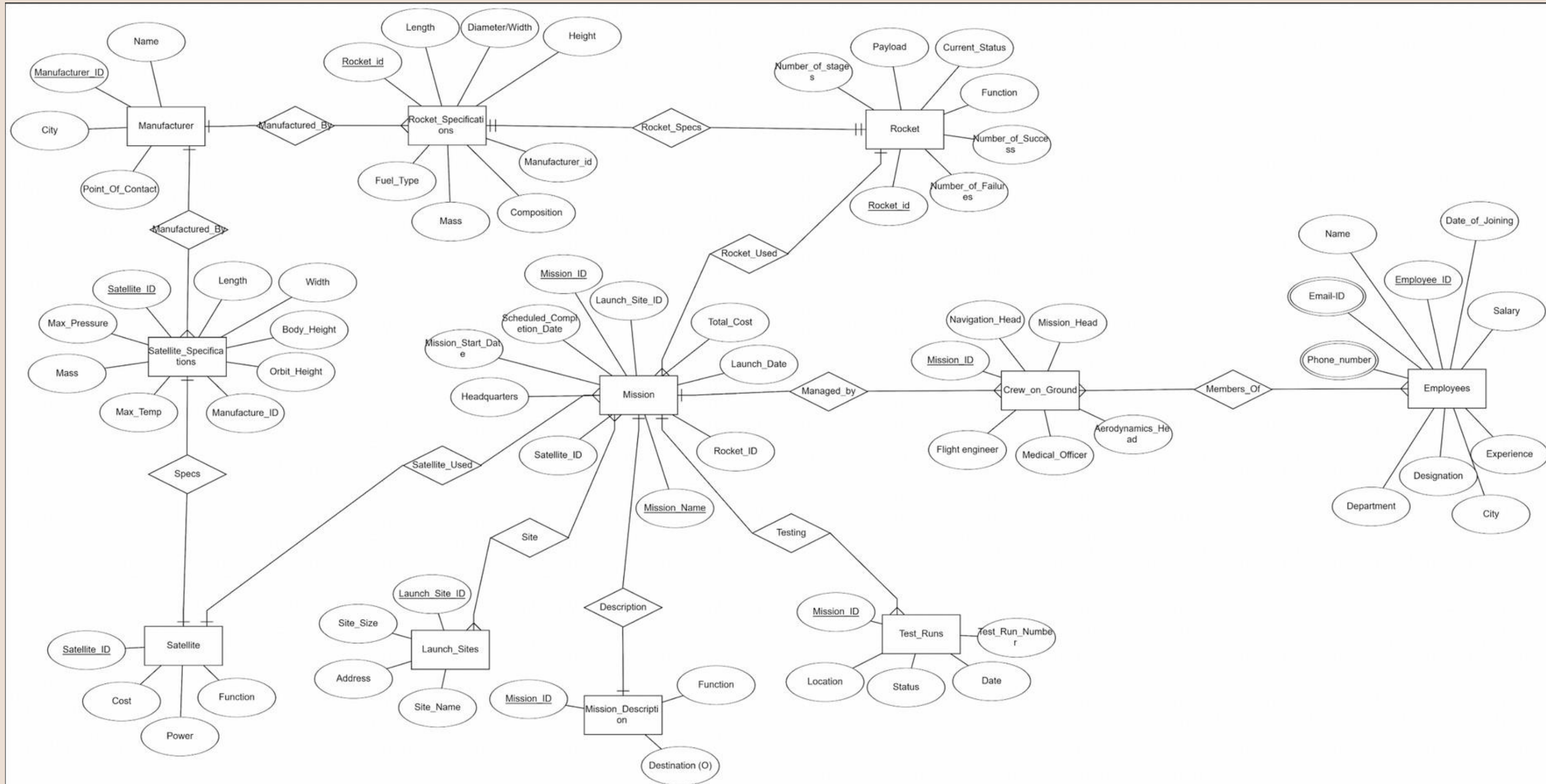
New ER Model:

The model is Normalized to achieve maximum efficiency and minimized data redundancy. To achieve this, we created a new Table called Manufacturer, as well as several more relationships to help in ease of data reading and stop redundancy and consistency anomalies. Creating a separate table for rocket and satellite specifications also helps in the same way. All the composite attributes contained in the Database were handled by adding their individual attributes to the related tables.

[illegible]



New ER Model:



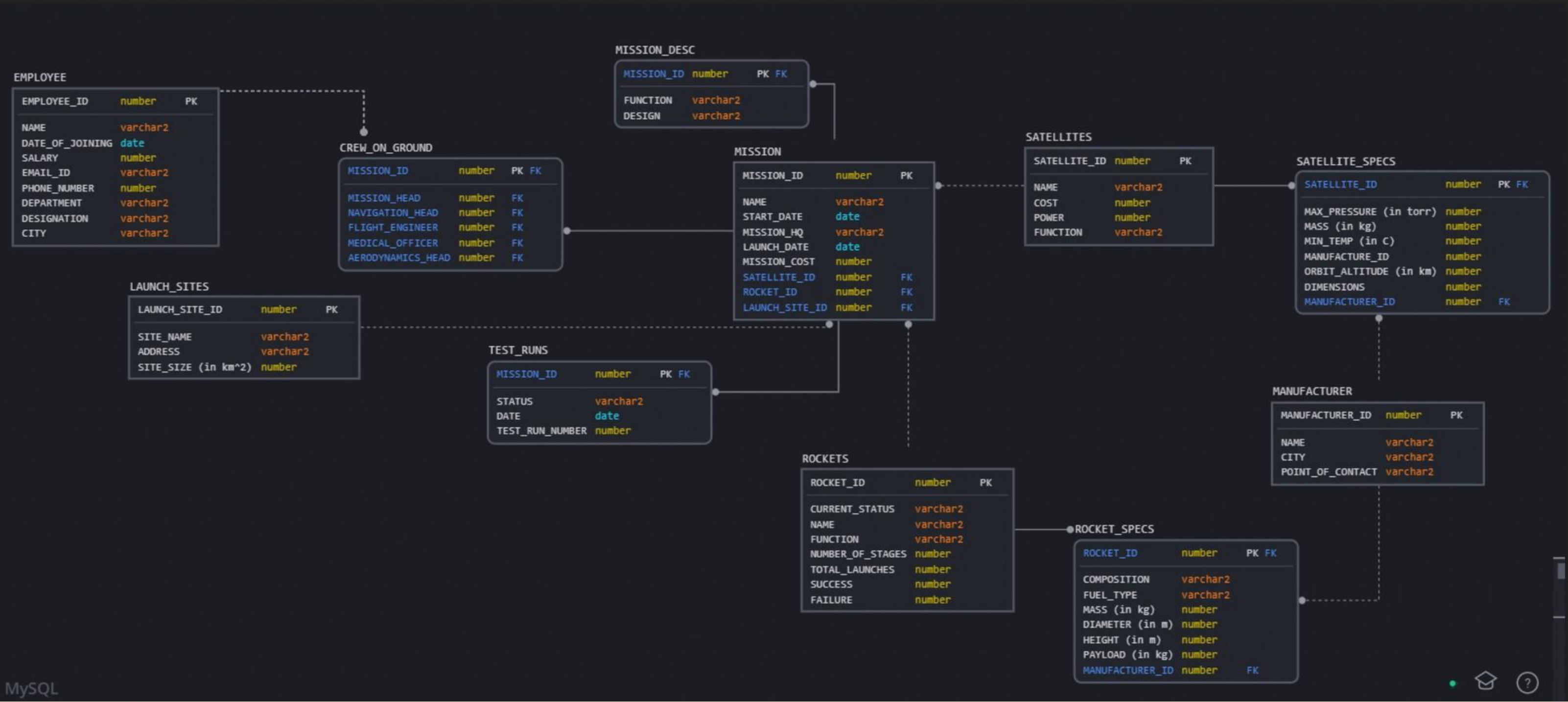


Assumptions made

- Attribute “Dimension” of ‘Rocket_specs’ and ‘Satellite_specs’ is a composite attribute but for the sake of normalization, it has been decomposed into ‘length’, ‘breadth’ and ‘height’ attributes.
- Rocket to Mission: The Rocket to Mission relationship is a One-To-Many relationship. One Rocket can be used in many Missions. It also involves total participation, that is every Mission must have a rocket.
- Satellite to Mission: It is a One-To-Many relationship i.e. One satellite can be part of many Missions.
- Mission to Launch Site: It is a Many-To-Many relationship i.e., multiple launch sites could be associated with multiple missions.
- Mission to Test Run: It is a One-To-Many relationship i.e. one mission can have one or more test runs.
- Crew_on_ground to Mission: It is a One - To - Many relationship as a single crew can be part of other missions too.
- Employee to Crew: Employees can be interchangeably part of various crews catering to various missions. Hence, they are Many-To-Many missions.



Relational Model





Tables used along with their attributes and constraints

MISSIONS

ATTRIBUTE	DATA TYPE	CONSTRAINTS
MISSION_ID	NUMBER(4)	PRIMARY KEY,NOT NULL

NAME	VARCHAR2(50)	NOT NULL
START_DATE	DATETIME	-
MISSION_HQ	VARCHAR2(100)	-
ROCKET_ID	NUMBER(4)	FOREIGN KEY
SATELLITE_ID	NUMBER(4)	FOREIGN KEY
LAUNCH_DATE	DATETIME	-
LAUNCH_SITE_ID	NUMBER(4)	FOREIGN KEY
MISSION_COST	NUMBER	-



Tables used along with their attributes and constraints

SATELLITES

ATTRIBUTE	DATA TYPE	CONSTRAINTS
SATELLITE_ID	NUMBER(4)	PRIMARY KEY, NOT NULL
NAME	VARCHAR2(15)	-
COST	NUMBER	-
POWER	NUMBER	-
FUNCTION	VARCHAR2(100)	-



Tables used along with their attributes and constraints

SATELLITE_SPECS

ATTRIBUTE	DATA TYPE	CONSTRAINTS
SATELLITE_ID	NUMBER(4)	FOREIGN KEY,PRIMARY KEY, NOT NULL
MAX_PRESSURE	NUMBER	-
MASS	NUMBER	-
MIN_TEMP	FLOAT(4)	-
MANUFACTURE_ID	NUMBER(4)	-
ORBITAL_ALTITUDE	FLOAT(7)	-
LENGTH	NUMBER	-
BREADTH	NUMBER	-
HEIGHT	NUMBER	-



Tables used along with their attributes and constraints

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ROCKETS

ATTRIBUTE	DATA TYPE	CONSTRAINTS
ROCKET_ID	NUMBER(4)	PRIMARY KEY,NOT NULL
CURRENT_STATUS	VARCHAR2(10)	-
NAME	VARCHAR2(20)	-
FUNCTION	VARCHAR2(100)	-

NUMBER_OF_STAGES	NUMBER	-
TOTAL_LAUNCHES	NUMBER	-
SUCCESS	NUMBER	-
FAILURE	NUMBER	-



Tables used along with their attributes and constraints

ROCKET_SPECS

ATTRIBUTE	DATA TYPE	CONSTRAINTS
ROCKET_ID	NUMBER(4)	PRIMARY KEY, FORIEGN KEY, NOT NULL
MANUFACTURE_ID	NUMBER(4)	FOREIGN KEY ,NOT NULL
COMPOSITION	VARCHAR2(20)	-
FUEL_TYPE	VARCHAR2(10)	-
MASS	NUMBER(10)	-
DIAMETER	NUMBER(3)	-
HEIGHT	NUMBER(3)	-
PAYLOAD	NUMBER(8)	-



Tables used along with their attributes and constraints

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MANUFACTURER

ATTRIBUTE	DATA TYPE	CONSTRAINTS
MANUFACTURE_ID	NUMBER(4)	PRIMARY KEY , NOT NULL
NAME	VARCHAR2(50)	-
CITY	VARCHAR2(20)	-
POINT_OF_CONTACT	VARCHAR2(20)	-



Tables used along with their attributes and constraints

MISSION_DESC

ATTRIBUTE	DATA TYPE	CONSTRAINTS
MISSION_ID	NUMBER(4)	PRIMARY KEY , FOREIGN KEY, NOT NULL
FUNCTION	VARCHAR2(200)	-
DESTINATION	VARCHAR2(30)	-



Tables used along with their attributes and constraints

EMPLOYEE

ATTRIBUTE	DATA TYPE	CONSTRAINTS
EMPLOYEE_ID	NUMBER(3)	PRIMARY KEY, NOT NULL
NAME	VARCHAR2(20)	-
DATE_OF_JOINING	DATETIME	-
SALARY	NUMBER(7)	-
EMAIL_ID	VARCHAR2(30)	-
PHONE_NUMBER	NUMBER(10)	-
DEPARTMENT	VARCHAR2(30)	-
DESIGNATION	VARCHAR2(15)	-
CITY	VARCHAR2(10)	



Tables used along with their attributes and constraints

CREW_ON_GROUND

ATTRIBUTE	DATA TYPE	CONSTRAINTS
MISSION_ID	NUMBER(3)	PRIMARY KEY, FOREIGN KEY, NOT NULL
MISSION_HEAD	VARCHAR2(20)	FOREIGN KEY
NAVIGATION_HEAD	DATETIME	FOREIGN KEY
FLIGHT_ENGINEER	NUMBER(7)	FOREIGN KEY
MEDICAL_OFFICER	VARCHAR2(30)	FOREIGN KEY
AERODYNAMICS_HE AD	NUMBER(10)	FOREIGN KEY



Tables used along with their attributes and constraints

LAUNCH_SITES

ATTRIBUTE	DATA TYPE	CONSTRAINTS
LAUNCH_SITE_ID	NUMBER(4)	PRIMARY KEY, NOT NULL
SITE_NAME	VARCHAR2(100)	-
ADDRESS	VARCHAR2(100)	-
SITE_SIZE	NUMBER	-

TEST_RUNS

ATTRIBUTE	DATA TYPE	CONSTRAINTS
MISSION_ID	NUMBER(4)	PRIMARY KEY , FOREIGN KEY, NOT NULL
STATUS	VARCHAR2(15)	-
RUN_DATE	DATETIME	-
TEST_RUN_NUMBE R	NUMBER	-



Creation and Insertion Commands

MISSIONS

MISSION_ID	NAME	START_DATE	MISSION_HQ	ROCKET_ID	SATELLITE_ID	LAUNCH_DATE	LAUNCH_SITE_ID	MISSION_COST
1001	Chandrayaan - 1	01-01-25	ISRO Satellite Centre,Bangalore	2001	3001	01-01-25	4002	3860000000
1002	Chandrayaan - 2	01-01-25	ISRO Satellite Centre,Bangalore	2002	3001	01-01-25	4002	9780000000
1003	Astrosat	01-01-25	ISSDC, Bylalu	2003	3003	01-01-25	4002	2100000000
1004	Cartosat	01-01-25	ISRO Satellite Centre,Bangalore	2004	3005	01-01-25	4002	5000000000
1005	Oceansat (IRS-P4)	01-01-25	EUMETSATheadquarters	2005	3002	01-01-25	4002	1900000000
1006	Risat	01-01-25	ISTRAC, Bangalore	2006	3004	01-01-25	4002	1020000000
1007	Mangalyaan	01-01-25	Indian Institute of Space Science andTechnology	2003	3006	01-01-25	4002	4500000000
1008	NISAR	01-01-25	ISRO Satellite Centre,Bangalore	2001	3007	01-01-25	4002	112390000000
1010	Shukrayaan	01-01-25	ISRO Satellite Centre,Bangalore	2001	3008	01-01-25	4002	700000000000



Creation and Insertion Commands

MISSIONS

```
CREATE TABLE MISSIONS(  
  MISSION_ID NUMBER(4) NOT NULL PRIMARY KEY ,  
  NAME VARCHAR2(50) NOT NULL ,  
  START_DATE DATETIME ,  
  MISSION_HQ VARCHAR2(100) ,  
  ROCKET_ID NUMBER(4) NOT NULL ,  
  SATELLITE_ID NUMBER(4) NOT NULL ,  
  LAUNCH_DATE DATETIME ,  
  LAUNCH_SITE_ID NUMBER(4) NOT NULL ,  
  MISSION_COST NUMBER ,  
  FOREIGN KEY (ROCKET_ID) REFERENCES ROCKETS(ROCKET_ID) ,  
  FOREIGN KEY (SATELLITE_ID) REFERENCES SATELLITES(SATELLITE_ID) ,  
  FOREIGN KEY (LAUNCH_SITE_ID) REFERENCES LAUNCH_SITES(LAUNCH_SITE_ID)  
);
```




Creation and Insertion Commands

MISSIONS

INSERT INTO MISSIONS VALUES

```
(1001.0,'Chandrayaan - 1','2003-08-15 00:00:00','ISRO Satellite Centre, Bangalore',2001.0,3001.0,'2008-10-22 00:00:00',4002.0,3860000000.0),
(1002.0,'Chandrayaan - 2','2007-11-12 00:00:00','ISRO Satellite Centre, Bangalore',2002.0,3001.0,'2019-07-22 00:00:00',4002.0,9780000000.0),
(1003.0,'Astrosat','2010-02-15 00:00:00','ISSDC, Bylalu',2003.0,3003.0,'2015-09-28 00:00:00',4002.0,2100000000.0),
(1004.0,'Cartosat','2005-05-05 00:00:00','ISRO Satellite Centre, Bangalore',2004.0,3005.0,'2019-11-27 00:00:00',4002.0,5000000000.0),
(1005.0,'Oceansat(IRS-P4)','1995-04-04 00:00:00','EUMETSAT headquarters',2005.0,3002.0,'1999-05-26 00:00:00',4002.0,1900000000.0),
(1006.0,'Risat','2010-01-01 00:00:00','ISTRAC, Bangalore',2006.0,3004.0,'2012-04-26 00:00:00',4002.0,1020000000.0),
(1007.0,'Mangalyaan','2008-11-23 00:00:00','Indian Institute of Space Science and Technology',2003.0,3006.0,'2013-11-05
00:00:00',4002.0,4500000000.0),
(1008.0,'NISAR','2019-05-01 00:00:00','ISRO Satellite Centre, Bangalore',2001.0,3007.0,'2023-01-01 00:00:00',4002.0,112390000000.0),
(1009.0,'Gaganyaan','2021-12-20 00:00:00','ISRO Satellite Centre, Bangalore',2002.0,NULL,'2023-01-01 00:00:00',4002.0,42570000000.0),
(1010.0,'Shukrayaan','2019-01-01 00:00:00','ISRO Satellite Centre, Bangalore',2001.0,3008.0,'2026-12-01 00:00:00',4002.0,700000000000.0),
```



Creation and Insertion Commands

SATELLITES

	⌘	SATELLITE_ID	⌘	NAME	⌘	COST	⌘	POWER	⌘	FUNCTION	
1		3001		Orbiter		8000000000		1000		Orbit Moon to create 3D maps of it	
2		3002		Oceansat		5000000000		750		Ocean applications	
3		3003		ASTROSAT-1		18000000000		1250		spectroscopy for studies of X-ray-emittingobjects	
4		3004		Risat		12000000000		2200		Satellite imaging	
5		3005		Cartosat-3		20000000000		2000		weather mapping, cartography or defence	
6		3010		Kalamsat		17000000000		1980		for payload	
7		3011		Rohini		11000000000		2100		sending valuable scientific data	
8		3007		Nisar		12000000000		6500		Earth observation satellite with dual frequency radar	
9		3006		Mangalyaan		15300000000		840		Explore morphology, mineralogy and martianatmosphere	
10		3008		Shukrayan-1		20000000000		500		geographical study of venus	



Creation and Insertion Commands

CREATION:

```
CREATE TABLE SATELLITES(  
  SATELLITE_ID NUMBER(4) NOT NULL PRIMARY KEY , NAME VARCHAR2(15) ,  
  COST NUMBER ,  
  POWER NUMBER ,  
  FUNCTION VARCHAR2(100)  
);
```

INSERTION:

INSERT INTO SATELLITES VALUES

```
(3001.0,'Orbiter',800000000.0,1000.0,'Orbit Moon to create 3D maps of it');  
(3002.0,'Oceansat',500000000.0,750.0,'Ocean applications');  
(3003.0,'ASTROSAT-1',1800000000.0,1250.0,'spectroscopy for studies of X-ray-emitting objects');  
(3004.0,'Risat',1200000000.0,2200.0,'Satellite imaging');  
(3005.0,'Cartosat-3',2000000000.0,2000.0,'weather mapping, cartography or defence');  
(3010.0,'Kalamsat',1700000000.0,1980.0,'for payload');
```



Creation and Insertion Commands

SATELLITE_SPECS

	⚡ SATELLITE_ID	⚡ MAX_PRESSURE	⚡ MASS	⚡ MIN_TEMP	⚡ MANUFACTURE_ID	⚡ ORBITAL_ALTITUDE	⚡ LENGTH	⚡ BREADTH	⚡ HEIGHT	
1	3001	1355	2379	-320	5003	100	3.2	5.8	2.2	
2	3002	800	1050	88	5002	720	2.8	1.98	2.57	
3	3005	1500	1625	-60	5004	509	3.5	4	2.14	
4	3010	600	1.26	43	5002	277	0.04	0.04	0.04	
5	3004	900	1858	60	5002	523	6.29	2.09	0.22	
6	3011	758	108	55	5002	70	2.2	3.4	6.7	
7	3007	780	2800	-100	5002	747	12	2	3	
8	3006	654	1337	-51	5004	422	1.5	1.5	1.5	
9	3008	2000	2500	-200	5004	500	5	4.5	3.12	
10	3003	1200	1513	80	5002	7020	6	5	3	



Creation and Insertion Commands

CREATION:

```
CREATE TABLE SATELLITE_SPECS(  
  SATELLITE_ID NUMBER(4) NOT NULL PRIMARY KEY,  
  MAX_PRESSURE NUMBER ,  
  MASS NUMBER ,  
  MIN_TEMP FLOAT(4),  
  MANUFACTURE_ID NUMBER(4) ,  
  ORBITAL_ALTITUDE FLOAT(7) ,  
  LENGTH NUMBER ,  
  BREADTH NUMBER ,  
  HEIGHT NUMBER ,  
  FOREIGN KEY (SATELLITE_ID) REFERENCES SATELLITES(SATELLITE_ID)  
);
```



Creation and Insertion Commands

INSERTION:

```
INSERT INTO SATELLITE_SPECS VALUES(3001.0,1355.0,2379.0,'-320.0',5003.0,100.0,3.2 ,5.8, 2.2);
INSERT INTO SATELLITE_SPECS VALUES(3002.0,800.0,1050.0,'87.78',5002.0,720.0,2.8 , 1.98 , 2.57);
INSERT INTO SATELLITE_SPECS VALUES(3003.0,1200.0,1513.0,'-80 ',5002.0,7020.0,6,5,3),
INSERT INTO SATELLITE_SPECS VALUES(3004.0,900.0,1858.0,'60.0',5002.0,523.0,6.29 ,2.09 , 0.220 );
INSERT INTO SATELLITE_SPECS VALUES(3005.0,1500.0,1625.0,'-60.0',5004.0,509.0,3.5, 4 , 2.14);
INSERT INTO SATELLITE_SPECS VALUES(3010.0,600.0,1.26,'43.0',5002.0,277.0,0.04 , 0.04 , 0.04);
INSERT INTO SATELLITE_SPECS VALUES(3011.0,758.0,108.0,'55.0',5002.0,70.0,2.2, 3.4 , 6.7);
INSERT INTO SATELLITE_SPECS VALUES(3007.0,780.0,2800.0,'-100.0',5002.0,747.0,12,2,3);
INSERT INTO SATELLITE_SPECS VALUES (3006.0,654.0,1337.0,'-51.0',5004.0,421.7,1.5, 1.5, 1.5),
INSERT INTO SATELLITE_SPECS VALUES(3008.0,2000.0,2500.0,'-200.0',5004.0,500.0,5 , 4.5 ,3.12);
```



Creation and Insertion Commands

ROCKETS

ROCKET_ID	CURRENT_STATUS	NAME	FUNCTION	NUMBER_OF_STAGES	TOTAL_LAUNCHES	SUCCESS	FAILURE
2002	Active	GSLV Mark III M1	Medium-lift launch vehicle	3	4	4	0
2003	Active	PSLV-XL	Medium-lift launch vehicle	4	53	2	50
2004	Inactive	PSLV-C9	Heavy-lift launch vehicle	5	16	10	6
2005	Active	PSLV-C14	solid and liquid propulsion launch vehicle	4	15	1	14
2006	Inactive	PSLV-XL-C19	expendable medium-lift launch vehicle	4	2	1	1
2011	Inactive	PSLV PS-4	launch vehicle	5	4	3	1
2012	Inactive	RH-200	expendable medium-lift launch vehicle	4	3	2	1
2001	Active	GSLV MK II	Medium-lift launch vehicle	3	23	19	4



Creation and Insertion Commands

CREATION:

```
CREATE TABLE ROCKETS(  
    ROCKET_ID NUMBER(4) NOT NULL PRIMARY KEY ,  
    CURRENT_STATUS VARCHAR2(10) ,  
    NAME VARCHAR2(20) ,  
    FUNCTION VARCHAR2(100) ,  
    NUMBER_OF_STAGES NUMBER ,  
    TOTAL_LAUNCHES NUMBER ,  
    SUCCESS NUMBER ,  
    FAILURE NUMBER  
);
```



Creation and Insertion Commands

INSERTION:

INSERT INTO ROCKETS VALUES

```
(2002.0,'Active','GSLV Mark III M1','Medium-lift launch vehicle',3.0,4.0,4.0,0.0),  
(2003.0,'Active','PSLV-XL','Medium-lift launch vehicle',4.0,53.0,2.0,50.0),  
(2004.0,'Inactive','PSLV-C9','Heavy-lift launch vehicle',5.0,16.0,10.0,6.0),  
(2005.0,'Active','PSLV-C14','solid and liquid propulsion launch vehicle',4.0,15.0,1.0,14.0),  
(2006.0,'Inactive','PSLV-XL-C19','expendable medium-lift launch vehicle',4.0,2.0,1.0,1.0),  
(2011.0,'Inactive','PSLV PS-4',' launch vehicle',5.0,4.0,3.0,1.0),  
(2012.0,'Inactive','RH-200','expendable medium-lift launch vehicle',4.0,3.0,2.0,1.0),  
(2001.0,'Active','GSLV MK II','Medium-lift launch vehicle',3.0,23.0,19.0,4.0);
```



Creation and Insertion Commands

ROCKET_SPECS

	ROCKET_ID	MANUFACTURE_ID	COMPOSITION	FUEL_TYPE	MASS	DIAMETER	HEIGHT	PAYLOAD
1	2001	5004	Maraging steel	Hydrogen	414000	3	49	5000
2	2002	5002	(null)	HTPB	640000	4	43	14000
3	2003	5001	maraging steel	HTPB	320000	3	44	1800
4	2004	5003	titanium	Hydrogen	550000	5	60	7800
5	2005	5002	titanium alloy	HTPB	1380000	3	20	960
6	2006	5002	titanium alloy	HTPB	320000	3	37	1750
7	2011	5002	titanium alloy	HTPB	1286	3	5	0
8	2012	5002	titanium alloy	HTPB	2100000	2	50	35



Creation and Insertion Commands

CREATION:

```
CREATE TABLE ROCKET_SPECS (  
  ROCKET_ID NUMBER(4) NOT NULL PRIMARY KEY,  
  MANUFACTURE_ID NUMBER(4) NOT NULL,  
  COMPOSITION VARCHAR2(20),  
  FUEL_TYPE VARCHAR2(10),  
  MASS NUMBER(10),  
  DIAMETER NUMBER(3),  
  HEIGHT NUMBER(3),  
  PAYLOAD NUMBER(8),  
  FOREIGN KEY (MANUFACTURE_ID) REFERENCES MANUFACTURER (MANUFACTURE_ID),  
  FOREIGN KEY (ROCKET_ID) REFERENCES ROCKETS(ROCKET_ID)  
);
```




Creation and Insertion Commands

INSERTION:

INSERT INTO ROCKET_SPECS VALUES

```
(2001.0,5004.0,'Maraging steel','Hydrogen',414000.0,2.8,49.0,5000.0),  
(2002.0,5002.0,NULL,'HTPB',640000.0,4.0,43.43,14000.0),  
(2003.0,5001.0,'maraging steel','HTPB',320000.0,3.2,44.0,1800.0),  
(2004.0,5003.0,'titanium ','Hydrogen',550000.0,5.0,60.0,7800.0),  
(2005.0,5002.0,'titanium alloy','HTPB',1380000.0,2.8,20.0,960.0),  
(2006.0,5002.0,'titanium alloy','HTPB',320000.0,2.8,37.0,1750.0),  
(2011.0,5002.0,'titanium alloy','HTPB',1286.0,3.1,4.6,0.1),  
(2012.0,5002.0,'titanium alloy','HTPB',2100000.0,2.1,50.0,35.0);
```



Creation and Insertion Commands

MANUFACTURER

	MANUFACTURE_ID	NAME	CITY	POINT_OF_CONTACT
1	5001	Vikram Sarabhai Space Centre	Thiruvananthapuram	S Somanath
2	5002	Indian Space Research Organisation	Bangalore	Kailasavadivoo Sivan
3	5003	Hindustan Aeronautics Limited	Bangalore	R Madhavan
4	5004	U R Rao Satellite Centre	Bangalore	Dr.P Kunhikrishnan



Creation and Insertion Commands

CREATION:

```
CREATE TABLE MANUFACTURER (  
  MANUFACTURE_ID NUMBER(4) NOT NULL PRIMARY KEY,  
  NAME VARCHAR2(50),  
  CITY VARCHAR2(20),  
  POINT_OF_CONTACT VARCHAR2(20)  
);
```

INSERTION:

INSERT INTO MANUFACTURER VALUES

```
(5001.0,'Vikram Sarabhai Space Centre','Thiruvananthapuram','S Somanath');  
INSERT INTO MANUFACTURER VALUES(5002.0,'Indian Space Research Organisation','Bangalore','Kailasavadivoo Sivan');  
INSERT INTO MANUFACTURER VALUES (5003.0,'Hindustan Aeronautics Limited','Bangalore','R Madhavan');  
INSERT INTO MANUFACTURER VALUES(5004.0,'U R Rao Satellite Centre','Bangalore','Dr. P Kunhikrishnan');
```



MISSION_DESC

MISSION_ID	FUNCTION	DESTINATION
1	1002 Study lunar topography and signatures of water ice and thickness of lunar regolith and map lunar surface to create 3D maps	Moon
2	1003 geocentric	Earth's orbit
3	1005 remote sensing oceanic applications	Polar Sun Synchronous orbit
4	1006 enables imaging of the surface features under all weather conditions.	Polar Sun Synchronous orbit
5	1004 weather mapping	Earth's orbit
6	1008 Dual-frequency synthetic aperture radar for remote sensing and tracking natural processes on Earth.	Earth's orbit
7	1007 Successfully develop an inter-planetary mission to observe the atmosphere and physical attributes of a planet	Mar's Orbit
8	1010 to study surface and atmosphere of Venus	Venus Orbit



CREATION:

```
CREATE TABLE MISSION_DESC (  
MISSION_ID NUMBER(4) NOT NULL PRIMARY KEY,  
FUNCTION VARCHAR2(200),  
DESTINATION VARCHAR2(30),  
FOREIGN KEY (MISSION_ID) REFERENCES MISSIONS (MISSION_ID)  
);
```



INSERTION:

INSERT INTO MISSION_DESC VALUES

(1001.0,'to design, develop, launch and orbit a spacecraft around the Moon using an Indian-made launch-vehicle and conduct experiments and to test the impact of a sub-satellite (Moon Impact Probe - MIP) on the surface of the Moon','Moon'),
(1002.0,'Study lunar topography and signatures of water ice and thickness of lunar regolith and map lunar surface to create 3D maps','Moon'),
(1003.0,'geocentric','Earth"s orbit'),
(1005.0,'remote sensing oceanic applications',' Polar Sun Synchronous orbit'),
(1006.0,'enables imaging of the surface features under all weather conditions.',' Polar Sun Synchronous orbit'),
(1004.0,'weather mapping','Earth"s orbit'),
(1011.0,'student payload','Earth"s orbit'),
(1012.0,'to detect Gamma Ray Bursts','Earth"s orbit'),
(1008.0,'Dual-frequency synthetic aperture radar for remote sensing and tracking natural processes on Earth.','Earth"s orbit'),
(1007.0,'Successfully develop an inter-planetary mission to observe the atmosphere and physical attributes of a planet','Mar"s Orbit'),
(1009.0,'first indian human space flight','Earth"s orbit'),
(1010.0,'to study surface and atmosphere of Venus','Venus Orbit');



NATIONAL INSTITUTE OF TECHNOLOGY WARANGAL

EMPLOYEE

	EMPLOYEE_ID	NAME	DATE_OF_JOINING	SALARY	EMAIL_ID	PHONE_NUMBER	DEPARTMENT	DESIGNATION	CITY
1	131003	BN Suresh	20-06-20	78000	sur@isro.ac.in	987659912	SpaceResearch	Sub Director	Kochi
2	131004	Tapan Mishra	20-06-20	93000	tap@isro.ac.in	9833765444	Satellite Development	NavigationHead	Kanpur
3	145002	N valarmithi	20-06-20	120000	valar@isro.ac.in	9996459913	Space Research	Chief Scientist	Chennai
4	145006	K S Sarma	20-06-20	55000	sarma@isro.ac.in	9127333219	Aeronautics Technology	LeadEngineer	Hyderabad
5	263005	Ritu Karidhal	14-12-95	140000	ritu@isro.ac.in	9834212100	AeronauticsTechnology	Physicist	Bhopal
6	145007	Nandagopal	14-12-95	94000	gopal@isro.ac.in	916545434	Space Research	Engineer	Madurai
7	263008	Kanika Jadeja	14-12-95	250000	kanika@isro.ac.in	9128663184	Satellite Development	SubDirector	Mangalore
8	271001	Moumita Dutta	14-12-95	200000	dutta@isro.ac.in	9128417316	Space Research	Chief Scientist	Kolkata
9	263006	MGK Menon	14-12-95	200000	menon@isro.ac.in	9128477312	Aeronautics Technology	SubDirector	Coimbatore
10	271003	Abhinay Singh	14-12-95	95000	abhinay@isro.ac.in	9731332159	AeronauticsTechnology	Physicist	Amritsar
11	192004	Vishnu Som	14-12-95	85000	som@isro.ac.in	9128477313	Satellite Development	Engineer	Udipi
12	192003	Vasudeva Reddy	14-12-95	110000	vasudeva@isro.ac.in	9834212101	Space Research	ChiefScientist	Belgaon
13	192005	Kurien Murali	01-01-22	140000	kurien@isro.ac.in	996545411	Aeronautics Technology	(null)	Vijaywada
14	192009	K. Sivan	01-01-92	250000	head@isro.ac.in	9012768915	Admin	Chairman	Nagercoil



CREATION:

```
CREATE TABLE EMPLOYEE (  
  EMPLOYEE_ID NUMBER NOT NULL PRIMARY KEY,  
  NAME VARCHAR2(20),  
  DATE_OF_JOINING DATETIME,  
  SALARY    NUMBER(7),  
  EMAIL_ID VARCHAR2(30),  
  PHONE_NUMBER NUMBER(10),  
  DEPARTMENT VARCHAR2(30),  
  DESIGNATION VARCHAR2(15),  
  CITY VARCHAR2(10)  
);
```




INSERTION:

INSERT INTO EMPLOYEE VALUES

```
(131003.0,'BN Suresh','20-06-20',78000.0,'sur@isro.ac.in',987659912.0,'Space Research','Sub Director','Kochi'),
(131004.0,'Tapan Mishra','20-06-20',93000.0,'tap@isro.ac.in',9833765444.0,'Satellite Development','Navigation Head','Kanpur'),
(145002.0,'N valarmithi','20-06-20',120000,'valar@isro.ac.in',9996459913.0,'Space Research','Chief Scientist','Chennai'),
(145006.0,'K S Sarma','20-06-20',55000.0,'sarma@isro.ac.in',9127333219.0,'Aeronautics Technology','Lead Engineer','Hyderabad'),
(145007.0,'Nandagopal','14-12-95',94000.0,'gopal@isro.ac.in',916545434.0,'Space Research','Engineer','Madurai'),
(263005.0,'Ritu Karidhal','14-12-95',140000,'ritu@isro.ac.in',9834212100.0,'Aeronautics Technology','Physicist','Bhopal'),
(263006.0,'MGK Menon','14-12-95',200000,'menon@isro.ac.in',9128477312.0,'Aeronautics Technology','Sub Director','Coimbatore'),
(263008.0,'Kanika Jadeja','14-12-95',250000,'kanika@isro.ac.in',9128663184.0,'Satellite Development','Sub Director','Mangalore'),
(271001.0,'Moumita Dutta','14-12-95',200000,'dutta@isro.ac.in',9128417316.0,'Space Research','Chief Scientist','Kolkata'),
(271003.0,'Abhinay Singh','14-12-95',95000.0,'abhinay@isro.ac.in',9731332159.0,'Aeronautics Technology','Physicist','Amritsar'),
(192004.0,'Vishnu Som','14-12-95',85000.0,'som@isro.ac.in',9128477313.0,'Satellite Development','Engineer','Udipi'),
(192003.0,'Vasudeva Reddy','14-12-95',110000,'vasudeva@isro.ac.in',9834212101.0,'Space Research','Chief Scientist','Belgaon'),
(192005.0,'Kurien Murali','01-01-22',140000,'kurien@isro.ac.in',996545411.0,'Aeronautics Technology',NULL,'Vijaywada'),
(192009.0,' K. Sivan','01-01-92',250000,'head@isro.ac.in',9012768915.0,'Admin ','Chairman ','Nagercoil');
```



CREW_ON_GROUND

	MISSION_ID	MISSION_HEAD	NAVIGATION_HEAD	FLIGHT_ENGINEER	MEDICAL_OFFICER	AERODYNAMICS_HEAD	
1	1002	131004	145006	263005	271003	192009	
2	1004	131003	145002	263006	271003	192004	
3	1005	131003	145006	263008	271001	192003	
4	1007	131003	145007	263005	271001	192004	
5	1008	131004	145002	263005	271003	192003	
6	1010	131004	145002	263005	271003	192004	



CREATION:

```
CREATE TABLE CREW_ON_GROUND(  
MISSION_ID NUMBER(4) NOT NULL PRIMARY KEY ,  
MISSION_HEAD NUMBER ,  
NAVIGATION_HEAD NUMBER ,  
FLIGHT_ENGINEER NUMBER ,  
MEDICAL_OFFICER NUMBER ,  
AERODYNAMICS_HEAD NUMBER ,  
FOREIGN KEY (MISSION_ID) REFERENCES MISSIONS(MISSION_ID),  
FOREIGN KEY(MISSION_HEAD) REFERENCES EMPLOYEE(EMPLOYEE_ID),  
FOREIGN KEY( NAVIGATION_HEAD) REFERENCES EMPLOYEE(EMPLOYEE_ID),  
FOREIGN KEY( FLIGHT_ENGINEER) REFERENCES EMPLOYEE(EMPLOYEE_ID),  
FOREIGN KEY(MEDICAL_OFFICER) REFERENCES EMPLOYEE(EMPLOYEE_ID),  
FOREIGN KEY(AERODYNAMICS_HEAD) REFERENCES EMPLOYEE(EMPLOYEE_ID)  
);
```



INSERTION:

```
INSERT INTO CREW_ON_GROUND VALUES(1001,131004,145007,263008,271001,192004);  
INSERT INTO CREW_ON_GROUND VALUES(1002,131004,145006,263005,271003,192009);  
INSERT INTO CREW_ON_GROUND VALUES(1003,131003,145007,263005,271008,192003);  
INSERT INTO CREW_ON_GROUND VALUES(1004,131003,145002,263006,271003,192004);  
INSERT INTO CREW_ON_GROUND VALUES(1005,131003,145006,263008,271001,192003);  
INSERT INTO CREW_ON_GROUND VALUES(1006,131004,145006,263006,271008,192009);  
INSERT INTO CREW_ON_GROUND VALUES(1007,131003,145007,263005,271001,192004);  
INSERT INTO CREW_ON_GROUND VALUES(1008,131004,145002,263005,271003,192003);  
INSERT INTO CREW_ON_GROUND VALUES(1009,131003,145007,263006,271008,192009);  
INSERT INTO CREW_ON_GROUND VALUES(1010,131004,145002,263005,271003,192004);  
INSERT INTO CREW_ON_GROUND VALUES(1011,131004,145006,263008,271008,192009);  
INSERT INTO CREW_ON_GROUND VALUES(1012,131004,145002,263006,271001,192004);
```




LAUNCH_SITES

	LAUNCH_SITE_ID	SITE_NAME	ADDRESS	SITE_SIZE
1	4001	Thumba Equatorial Rocket LaunchingStation	Thumba, Thiruvananthapuram	130
2	4002	Satish Dhawan Space Centre Second LaunchPad	Sriharikota in Andhra Pradesh	145



NATIONAL INSTITUTE OF TECHNOLOGY WARANGAL

CREATION:

```
CREATE TABLE LAUNCH_SITES(  
  LAUNCH_SITE_ID NUMBER(4) NOT NULL PRIMARY KEY ,  
  SITE_NAME VARCHAR2(100),  
  ADDRESS VARCHAR2(100),  
  SITE_SIZE NUMBER  
);
```

INSERTION:

```
INSERT INTO LAUNCH_SITES VALUES(4001,'Thumba Equatorial Rocket Launching Station','Thumba, Thiruvananthapuram',130);  
INSERT INTO LAUNCH_SITES VALUES(4002,'Satish Dhawan Space Centre Second Launch Pad','Sriharikota in Andhra Pradesh',145);
```



TEST_RUNS

	MISSION_ID	STATUS	RUN_DATE	TEST_RUN_NUMBER	
1	1010	DUE	(null)	(null)	
2	1001	COMPLETED	20-09-08	5	
3	1002	COMPLETED	19-11-14	2	
4	1003	DUE	20-12-24	3	
5	1005	COMPLETED	20-08-08	4	
6	1006	COMPLETED	12-04-26	3	
7	1004	delayed	29-05-23	3	
8	1008	delayed	22-01-01	1	
9	1007	COMPLETED	14-09-24	4	



CREATION:

```
CREATE TABLE TEST_RUNS(  
  MISSION_ID NUMBER(4) NOT NULL ,  
  STATUS VARCHAR2(15) ,  
  RUN_DATE DATETIME,  
  TEST_RUN_NUMBER NUMBER ,  
  FOREIGN KEY(MISSION_ID) REFERENCES MISSIONS(MISSION_ID),  
  PRIMARY KEY(MISSION_ID)  
);
```




INSERTION:

INSERT INTO TEST_RUNS VALUES

```
(1001.0,'COMPLETED','2008-09-08 00:00:00',5.0),  
(1002.0,'COMPLETED','2019-11-14 00:00:00',2.0),  
(1003.0,'DUE ','2010-12-24 00:00:00',3.0),  
(1005.0,'COMPLETED','2010-08-08 00:00:00',4.0),  
(1006.0,'COMPLETED','2012-04-26 00:00:00',3.0),  
(1004.0,'delayed','2019-05-23 00:00:00',3.0),  
(1008.0,'delayed','2022-01-01 00:00:00',1.0),  
(1007.0,'COMPLETED','2014-09-24 00:00:00',4.0),  
(1009.0,'DUE ',NULL,NULL),  
(1010.0,'DUE ',NULL,NULL),  
(1011.0,'COMPLETED','2019-01-24 00:00:00',4.0),  
(1012.0,'COMPLETED','2010-07-07 00:00:00',3.0);
```



Conclusion

From this project, we can get an understanding of database design and how it can be applied to a real-life scenario like that of an ISRO Database Management System.

We have used the theory developed on commercial databases to intuitively design this database. Although a practical ISRO Database will have many more dependencies and a much more complex design, it will be centered around our basic design.

We have briefly created some relational schemas and normal forms for our database, which gives better understanding of implementation level design.

