B.Tech in Data Science and Engineering

Preamble to the program:

Data science has become important due to recent technology disruptions. Most fundamental is Moore's Law which has driven an exponential growth in computing, storage, and communications per rupee over the past 50 years. This rate of growth shows no signs of abating. Consequently, today we have the Internet of Things: a plethora of sensors costing 10s of rupees or less, a global Internet with almost limitless bandwidth, and enormous storage in global clouds. The present era is full of technological advances in almost all spectrum of life and we are flooded with enormous amount of data. There is an increasing demand of capturing, analyzing, and synthesizing this large amount of data sets in a number of application domains to better understand various phenomena and to convert the information available in the data into actionable strategies such as new scientific discoveries, business applications, policy making, and healthcare etc.

Data science is the area where applications of various tools and techniques from the disciplines of applied statistics, mathematics and computer science are used to get greater insight and to make better and informed decisions for various purposes by analysing a large amount of data.

Jim Gray, database pioneer, has called Data Science the 4th paradigm of science. The first 3 are the empirical, the theoretical and the computational paradigms.

In industry there is an escalating demand for trained professionals who can collect, process, and study the large data sets and reveal underlying trend and other insights. Consequently, the study of data science as a discipline has become essential to cater the growing need for professionals and researchers to deal with the future challenges.

Given the mounting importance of the data science paradigm, IIT Mandi has decided to start a new 4 years bachelor program on Data Science and Engineering (DSE).

The curriculum of the DSE program focuses on exposing to the students with the essentials of applied statistics, applied mathematics, and computer science required in the context of data science and its applications with strong emphasis on having hands-on experience with the help of practicum, labs and experience of dealing with real-world problems.

Objectives of the program:

After the completion of the degree, students would

- Be prepared with a varied range of expertise in different aspects of data science such as data collection, visualization, processing and modeling of large data sets.
- Acquire good understanding of both the theory and application of applied statistics mathematics and computer science based existing data science models to analyse huge data sets originating from diversified application areas.
- Be able to create models using the knowledge acquired from the program to solve future challenges and real-world problems requiring large scale data analysis.
- Be better trained professionals to cater the growing demand for data scientists and engineers in industry.

List of Core courses for Data Science and Engineering Program

(Total Credits for discipline core = 30)

S. No.	Course Title	Lecture	Tutorial	Practical	Total Credit	Semester
1	Data handling and visualization	2	0	2	3	III
2	Mathematical Foundations of Data Science I	3	0	0	3	III

3	Introduction to Data structures and Algorithms	2	0	2	3	IV
4	Statistical Foundations of Data Science	3	0	0	3	IV
5	Mathematical Foundations of Data Science II	3	0	0	3	V
6	Matrix Computations for Data Science	2	0	2	3	V
7	Information Security and Privacy	3	0	0	3	V
8	Computing for Data Science	2	0	2	3	VI
9	Introduction to Statistical Learning	3	0	2	3	VI
10	Optimization for Data Science	3	0	0	3	VI

Semester wise distribution of all courses

(Minimum credit requirements for B.Tech. degree 160 credits)

Abbreviations	
IC	Institute Core Subject (Compulsory to all branches of B.Tech.)
DC	Discipline Core Subject (branch specific compulsory courses)
DE	Discipline Elective Subject (branch specific elective courses)
OE	Open Elective (elective open to all branches of B.Tech.)
MTP (total 8 credits)	Major Technical Project (Optional, students may opt for courses instead)

B.Tech (Data Science and Engineering) - 1st Sem.						
S. No.	**Core/ Elective**	**Course Name**	**Lecture**	**Tutorial**	**Practical**	**Credit**
1	IC110	Engineering Mathematics	2.5	0.5	0	3
2	IC152	Computing and Data Science	3	0	2	4
3	IC160	Electrical Systems Around Us	2.5	0.5	0	3
	IC160P	Electrical Systems Around Us Lab	0	0	3	2
4	IC 140	Graphics for design	2	0	3	4
5	IC101P	Reverse Engineering	0	0	3	2
6	ICXXX	HSS Course: Creative Understanding (5WIP)	1	0	0	1
7	HS106	English 1	3	0	0	3
					Total Credit	**22**

B.Tech (Data Science and Engineering) – 2nd Sem.						
S.No.	**Core/ Elective**	**Course Name**	**Lecture**	**Tutorial**	**Practical**	**Credit**
1	IC111	Linear Algebra	2.5	0.5	0	3
2	IC252	Data Science 2	3	0	2	4
3	IC161	Applied Electronics	3	0	0	3
	IC161P	Applied Electronics Lab	0	0	3	2
4	IC142	Engineering Thermodynamics	3	1	0	4

5	IC141	Product Realization Technology	2	0	0	2
6	IC141P	Product Realization Technology Lab	0	0	3	2
7	HSXXX	Language Basket Course	3	0	0	3
					Total Credit	**23**

B.Tech (Data Science and Engineering) – 3rd Sem.						
S.No.	**Core/ Elective**	**Course Name**	**Lecture**	**Tutorial**	**Practical**	**Credit**
1	IC121	Mechanics of Particles and Waves	2.5	0.5	0	3
2	**DS201**	**Data handling and visualization**	**2**	**0**	**2**	**3**
3	**DS203**	**Mathematical Foundations of Data Science I**	**3**	**0**	**0**	**3**
4	ICXXX	Data Science 3 + Lab	2	0	2	3
5	IC260	Signals and Systems	2.5	0.5	0	3
6	HSXXX	HSS Course	3	0	0	3
					Total Credit	**18**

B.Tech (Data Science and Engineering) – 4th Sem.						
S.No.	**Core/ Elective**	**Course Name**	**Lecture**	**Tutorial**	**Practical**	**Credit**
1	IC241	Materials Science for Engineers	3	0	0	3
2	IC221	Foundations of Electrodynamics	3	0	0	3
3	IC222P	Physics Practicum	0	0	3	2
4	IC242	Continuum Mechanics	2.5	0.5	0	3
5	IC201P	Design Practicum	0	0	6	4
5	**DS202**	**Introduction to Data structures and Algorithms**	**2**	**0**	**2**	**3**
6	**DS303**	**Statistical Foundations of Data Science**	**3**	**0**	**0**	**3**
		Design Practicum			**Total Credit**	**21**

B.Tech (Data Science and Engineering) – 5th Sem.						
S.No.	**Core/ Elective**	**Course Name**	**Lecture**	**Tutorial**	**Practical**	**Credit**
1	IC240	Mechanics of Rigid Bodies	1.5	1.5	0	3
2	IC136	Understanding Biotechnology & Its Applications	3	0	0	3
3	IC130	Applied Chemistry for Engineers	3	0	2	5
4	IC130P	Chemistry Practicum	0	0	3	2
5	**DS402**	**Matrix Computations for Data Science**	**2**	**0**	**2**	**3**
6	**DS301**	**Mathematical Foundations of Data Science II**	**3**	**0**	**0**	**3**
7	**DS404**	**Information Security and Privacy**	**3**	**0**	**0**	**3**
				Total Credit		**20**

B.Tech (Data Science and Engineering) - 6th Sem.						
S. No.	**Core/ Elective**	**Course Name**	**Lecture**	**Tutorial**	**Practical**	**Credit**
1	**DS403**	**Introduction to Statistical Learning**	**3**	**0**	**2**	**3**
2	**DS302**	**Computing Systems for Data Processing**	**3**	**0**	**3**	**3**
3	**DS401**	**Optimization for Data Science**	**3**	**0**	**0**	**3**
4	DE-1	Discipline elective				3 / 4
5	DE-2	Discipline elective				3 / 4
6	OE-1	Open Elective				3 / 4
				Total Credit		**18-21**

B.Tech (Data Science and Engineering) – 7th Sem.						
S.No.	**Core/ Elective**	**Course Name**	**Lecture**	**Tutorial**	**Practical**	**Credit**
1	DE-3	Discipline elective				3 / 4
2	DE-4	Discipline elective				3 / 4
3	OE-4	Open Elective				3 / 4
4	OE-5	Open Elective				3 / 4
5	OE-6	Open Elective				3 / 4
6	DP	MTP-I	0	0	0	3
				Total Credit		**18-21**

B.Tech (Data Science and Engineering) – 8th Sem.						
S.No.	**Core/ Elective**	**Course Name**	**Lecture**	**Tutorial**	**Practical**	**Credit**
1	OE-7	Open Elective				3 / 4
2	OE-8	Open Elective				3 / 4
3	OE-9*	Open Elective				3 / 4
4	OE-10*	Open Elective				3 / 4
5	DP	MTP-II	0	0	0	5
					Total Credit	12-18
				Completed Credits		**158 + 2 (internship) = 160**

* May not be required if candidate has completed sufficient credits in the earlier semesters.

Tentative list of elective courses

Sr. No.	Course title	Credit	Suggestive Baskets
1	Pattern Recognition	4	**Machine Learning**
2	Deep Learning	4	
3	Estimation and Detection Theory	3	
4	Kernel Methods for Pattern Analysis	4	
5	Digital Image Processing	4	
6	Computer Vision	4	
7	Biomedical Image and Signal Proc.	4	
1	IoT systems and the Cloud	3	**Networks and Distributed Computing**
2	Computer Networks	3	
3	High Performance Computing	2	
1	Algorithm Design and Algorithms	4	**Theoretical Computer Science**
2	Formal Concept Analysis: Theory and Practice	3	
3	Formal Languages and Automata Theory	3	
4	Semantic Analysis	4	
1	Linear Algebra	4	**Applied Mathematics**
2	Numerical Analysis	2	
3	Ordinary Differential Equations	3	
4	Introduction to Partial Differential Equations for Engineers	4	
1	Time Series	3	**Statistics and Optimization**
2	Optimization for Machine Learning	3	
3	Numerical Methods in Finance	3	
4	Computational Financial Modelling	3	
1	Cognitive Modelling	3	**Neuroscience Basket**
2	Computational Neuroscience	3	
3	Brain Inspired Computing	3	
4	Computational and Cognitive models of perception: Vision, Sound	3	