Study & Evaluation Scheme

Of

Bachelor of Technology
Computer Science & Engineering

With Specialization in

Data Science

(In Collaboration with iNurture)

(Based on Choice Based Credit System)

[Applicable w.e.f. Academic Session 2020-21]

COLLEGE OF COMPUTING SCIENCES AND INFORMATION TECHNOLOGY

TEERTHANKER MAHAVEERUNIVERSITY

N.H.-24, Delhi Road, Moradabad, UttarPradesh-244001 Website:www.tmu.ac.in

TEERTHANKER MAHAVEERUNIVERSITY

(EstablishedunderGovt.ofU.P.ActNo.30,2008)

Delhi Road, Bagarpur, Moradabad (U.P)

Study & Evaluation Scheme	
SUMMARY	
Institute Name	*College of Computing Sciences and Information Technology (CCSIT), Delhi Road, Moradabad*
Programme	*B.Tech. CSE (Data Science)*
Duration	*Four Years full time(Eight Semesters)*
Medium	*English*
Minimum Required Attendance	*75%*
Credits	
Maximum Credits	*180*
Minimum Credits Required for Degree	*172*

Assessment:

Evaluation			**Internal**	**External**	**Total**
Theory			40	60	100
Practical/ Dissertations/ Project Reports/ Viva-Voce			50	50	100
Class Test-1	**Class Test-2**	**Class Test-3**	**Assignment(s)**	**Attendance & Participation**	**Total**
Best two out of three					
10	10	10	10	10	40
Duration of Examination			**External**	**Internal**	
			3 Hours	1.5 Hours	

To qualify the course a student is required to secure a minimum of 45% marks in aggregate including the semester end examination and teachers continuous evaluation.(i.e. both internal and external).A candidate who secures less than 45% of marks in a course shall be deemed to have failed in that course. The student should have at least 45% marks in aggregate to clear the semester.

 # Provision for delivery of 25% content through online mode.

 # Policy regarding promoting the students from semester to semester & year to year. No specific condition to earn the credit for promoting the students from one semester to next semester.

 # Maximum Duration: Maximum no of years required to complete the program: N+2 (N=No of years for program for B.TECH(CSE) N=4)

	Question Paper Structure
1	*The question paper shall consist of six questions. Out of which first question shall be of short answer type (not exceeding 50 words) and will be compulsory. Question no. 2 to 6 (from Unit-I to V) shall have explanatory answers (approximately 350 to 400 words) along with having an internal choice within each unit.*
2	*Question No. 1 shall contain 8 parts from all units of the syllabus with at least one question from each unit and students shall have to answer any five, each part will carry 2 marks.*
3	*The remaining five questions shall have internal choice within each unit; each question will carry 10 marks.*
	IMPORTANT NOTES:
1	*The purpose of examination should be to assess the Course Learning Outcomes (CO) that will ultimately lead to of attainment of Programme Specific Outcomes (PSOs). A question paper must assess the following aspects of learning: Remember, Understand, Apply, Analyze, Evaluate & Create (reference to Bloom's Taxonomy).*
2	*Case Study is essential in every question paper (wherever it is being taught as a part of pedagogy) for evaluating higher-order learning. Not all the courses might have case teaching method used as pedagogy.*
3	*There shall be continuous evaluation of the student and there will be a provision of fortnight progress report.*

Program Structure-B.Tech.(Data Science)

A. Introduction:

High-quality technical education is essential for the digital age and using technology is powerful way to enhance changing requirements of the corporate, business enterprises and society. B.Tech students should be equipped to work across time zones, languages, and cultures. Employability, innovation, theory to practice connectedness is the central focus of B.Tech curriculum. The curriculum is designed as such that the students can gain an in-depth mastery of the academic disciplines and applied functional areas necessary to meet the requirements of IT enterprises and the industry.

The institute emphasis on the following courses ***balanced with core and elective courses:*** The curriculum of B.Tech program emphasizes an intensive, flexible technical education with 112 credits of core courses (all types), 22 credits of electives and 46 credits of Lab Work and internship/projects. Total 180 credits are allotted for the B.Tech(DS) degree.

The programme structure and credits for B.Tech(DS) are finalized based on the stakeholders' requirements and general structure of the programme. Minimum number of classroom contact teaching credits for the B.Tech(DS) program will be 154 credits (one credit equals 10 hours); Project/internship will be of 18 credits. However, the minimum number of the credits for award of B.Tech(DS) degree will be 172 credits. Out of 154 credits of classroom contact teaching, 16 credits are to be allotted for Basic Science Courses (BSC), 14 credits are allotted to Engineering Science Courses (ESC), 16 credits are allotted to Humanities and Social Sciences including Management Courses (HSMC), 63 credits are allotted to Professional Core Courses (PCC), 19 credits are allotted to Professional Elective Courses (PEC), 3 credits are allotted to Open Elective Courses(OEC), 3 credits are allotted to Mandatory Courses(MC) and rest of 28 credits for Laboratory Courses (LC).

The institute offers **B.Tech CSE with Specialization in Data Science** due to the amount of

data that is being generated and the evolution in the field of Analytics, Data Science has turned out to be a necessity for companies. To make most out of their data, companies from all domains, be it Finance, Marketing, Retail, IT or Bank. All are looking for Data Scientists. This has led to a huge demand for Data Scientists all over the globe. Thus this degree course help our student to find good and relative job in this field.

Course handouts for students will be provided in every course. A course handout is a thorough teaching plan of a faculty taking up a course. It is a blueprint which will guide the students about the pedagogical tools being used at different stages of the syllabus coverage and more specifically the topic-wise complete plan of discourse, that is, how the faculty members treat each and every topic from the syllabus and what they want the student to do, as an extra effort, for creating an effective learning. It may be a case study, a role-play, a classroom exercise, an assignment- home or field, or anything else which is relevant and which can enhance their learning about that particular concept or topic. Due to limited availability of time, most relevant topics will have this kind of method in course handout.

B.Tech(DS) : Four-Year (8-Semester) CBCS Programme			
Basic Structure: Distribution of Courses			
S.No.	**Type of Course**	**Credit Hours**	**Total Credits**
1	Basic Science Courses(BSC)	4 Courses of 4 Credit Hrs. each (Total Credit Hrs. 4X4)	16
2	Engineering Science Courses(ESC)	2 Courses of 4 Credit Hrs. each (Total Credit Hrs. 2X4) 2 Courses of 3 Credit Hrs. each (Total Credit Hrs. 2X3)	14
3	Humanities and Social Sciences including Management Courses(HMSC)	4 Courses of 3 Credit Hrs. each (Total Credit Hrs. 4X3) 2 Courses of 2 Credit Hrs. each (Total Credit Hrs. 2X2)	16
4	Professional Core Courses(PCC)	21 Courses of 3 Credit Hrs. each (Total Credit Hrs. 21X3)	63
5	Professional Elective Courses(PEC)	5 Courses of 3 Credit Hrs. each (Total Credit Hrs. 5X3) 1 Courses of 4 Credit Hrs. each (Total Credit Hrs. 1X4)	19
6	Open Elective Courses(OEC)	1 Course of 3 Credit Hrs. each (Total Credit Hrs.1X3)	3
7	Mandatory Courses(MC)	1 Courses of 3 Credit Hrs. each (Total Credit Hrs. 1X3)	3
8	Laboratory Courses(LC)	11 Course of 2 Credit Hrs. each (Total Credit Hrs.11X2) 6 Course of 1 Credit Hrs. each (Total Credit Hrs.6X1)	28
9	Project(PROJ)	1 Course of 10 Credit Hrs. each (Total Credit Hrs. 1X10) 1 Course of 4 Credit Hrs. each (Total Credit Hrs. 1X4) 4 Course of 1 Credit Hrs. each (Total Credit Hrs. 4X1)	18
Total Credits			**180**

Contact hours include work related to Lecture, Tutorial and Practical (LTP), where our institution will have flexibility to decide course wise requirements.

B. Choice Based Credit System (CBCS)

Choice Based Credit System (CBCS) is a versatile and flexible option for each student to achieve his target number of credits as specified by the UGC and adopted by our University.

The following is the course module designed for the B.Tech program:

Basic Science Courses (BSC): Basic Science courses include compulsory courses. Compulsory courses cater to all departments: it consists of Mathematic courses, Physics course, Chemistry course, Physics and Chemistry laboratories. The basic foundation is important for students because it will not only allow them to build upon existing skills, but they can also set the path for good career options. We offer basic science courses in semester I & II during the B.Tech program which common for all B.Tech first year students. There will be total 16 credits for basic science course offered.

Engineering Science Courses (ESC): Engineering Science completely opens the doors to different specializations. The goal of this course is to create engineers of tomorrow who possess the knowledge of all disciplines and can apply their interdisciplinary knowledge in every aspect. Engineering Science Courses including Basic Engineering courses such as Basic Workshop, Engineering Drawing, Engineering Basics of Electrical and Electronics. A strong foundation of engineering skill set is provided through these Engineering Science courses. We offer engineering science courses in semester I & II during the B.Tech program. There will be total 14 credits for engineering science course offered.

Humanities and Social Sciences including Management Courses (HMSC): All the Humanities and Social Science courses should compulsorily be studied by a student. These courses help students to their personal and social development. We offer Humanities and Social Sciences courses in semester I, II, III, IV & VI during the B.Tech program. There will be total 13 credits for Humanities and Social Sciences courses offered.

Professional Core Courses (PCC): Professional Core courses introducing the students to the foundation of engineering topics related to the chosen programme of study comprising of theory and Practical. These core courses are the strong foundation to establish Technical knowledge and provide broad multi-disciplined knowledge can be studied further in depth during the elective phase. The core courses will provide more practical-based knowledge and collaborative learning models. . It will train the students to understand, analyze and implement their knowledge. It help to develop decision-making ability of student and contribute to the industry and community at large. We offer Professional Core courses in semester III, IV, V, VI & VII during the B.Tech program. There will be total 65 credits for Professional Core courses offered.

Professional Elective Courses (PEC): Professional elective course can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline or nurtures the student's proficiency/skill. We offer Professional elective courses in semester IV, V, VI, VII & VIII during the B.Tech program. There will be total 20 credits for Professional elective courses offered.

Open Elective Courses (OEC): An open elective course chosen generally from other discipline/ subject, with an intention to seek interdisciplinary exposure. We offer Open elective courses in semester VII & VIII during the B.Tech program. There will be total 3 credits for Open elective courses offered.

Mandatory Courses (MC): This is a compulsory course that does not have any choice and will be in 3 credits. Each student of B.Tech program has to compulsorily pass the course and acquire 3 credits. We offer Mandatory courses in semester Ist during the B.Tech program.

Laboratory Courses (LC): A laboratory oriented course which will provide a platform to students to enhance their practical knowledge and skills by development of small application/project. We offer Laboratory courses in semester I, II, III, IV, V, VI & VII during the B.Tech program. There will be total 28 credits for Open elective courses offered.

Project (PROJ): Every student must do one major project in the 8th Semester. The

minimum duration of project is 6 months. Students can do their major project in Industry or R&D Lab or in house or combination of any two. There will be total 18 credits for Project course offered.

C. PROGRAMME OUTCOMES (POs):

PO – 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO – 2	**Problem analysis& Solving:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO – 3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO – 4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO – 5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO – 6	**Social Interaction & effective citizenship:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO – 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO – 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO – 9	**Attitude (Individual and team work):** Function effectively as an individual, and as member or leader in diverse teams, and in multidisciplinary settings.
PO– 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clean instructions.
PO– 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO- 12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PO-13	**Entrepreneurship:** An Entrepreneurship cut across every sector of human life including the field of engineering, engineering entrepreneurship is the process of harnessing the business opportunities in engineering and turning it into profitable commercially viable innovation.
PO-14	**Interpersonal skills:** Interpersonal skills involve the ability to communicate and build relationships with others. Effective interpersonal skills can help the students during the job interview process and can have a positive impact on your career advancement.
PO-15	**Technology savvy/usage:** Being technology savvy is essentially one's skill to be smart with technology. This skill reaches far beyond 'understanding' the concepts of how technology works and encompasses the 'utilization' of such modern technology for the purpose of enhancing productivity and efficiency.

D. Programme Specific Outcomes (PSOs)

The learning and abilities or skills that a student would have developed by the end of Four-year **B.Tech(DS)**

PSO – 1	Understanding Data Science concepts, techniques & tools used in IT industry.
PSO – 2	Applying the knowledge of programming skills to create applications in the field of Data Science.
PSO – 3	Implementing different machine learning algorithms on different data sets.
PSO – 4	Developing Big Data solutions for real life scenario.

E. Pedagogy & Unique practices adopted: "Pedagogy is the method and practice of teaching, especially for teaching an academic subject or theoretical concept". In addition to conventional time-tested lecture method, the institute will **emphasize on experiential learning:**

***1. Case Based Learning*:** Case based learning enhances student skills at delineating the critical decision dilemmas faced by organizations, helps in applying concepts, principles and analytical skills to solve the delineated problems and develops effective templates for business problem solving. Case method of teaching is used as a critical learning of technology specific tools for effective learning and implementation to fullest. We encourage students to implement different tools to develop various applications and projects based on the case studies.

2. Role Play & Simulation: Role-play and simulation are forms of experiential learning. Learners take on different roles, assuming a profile of a character or personality, and interact and participate in diverse and complex learning settings. Role-play and simulation function as learning tools for teams and groups or individuals as they "play" online or face-to-face. They alter the power ratios in teaching and learning relationships between students and educators, as students learn through their explorations and the viewpoints of the character or personality they are articulating in the environment. This student-centered space can enable learner-oriented assessment, where the design of the task is created for active student learning. Therefore, role-play& simulation exercises such as UI designing, Technical presentation and S/w or H/W simulation etc. are being promoted for the practical-based experiential learning of our students.

3. Video Based Learning (VBL) & Learning through Movies (LTM): These days

technology has taken a front seat and classrooms are well equipped with equipment and gadgets. Video-based learning has become an indispensable part of learning. Similarly, students can learn various concepts through movies. In fact, many teachers give examples from movies during their discourses. Making students learn few important theoretical concepts through VBL & LTM is a good idea and method. The learning becomes really interesting and easy as videos add life to concepts and make the learning engaging and effective. Therefore, our institute is promoting VBL & LTM, wherever possible.

***4. Field / Live Projects*:** The students, who take up experiential projects in companies, where senior executives with a stake in teaching guide them, drive the learning. All students are encouraged to do some live project other their regular classes.

5. Industrial Visits: Industrial visit are essential to give students hand-on exposure and experience of how things and processes work in industries. Our institute organizes such visits to enhance students' exposure to practical learning and work out for a report of such a visit relating to their specific topic, course or even domain.

6. MOOCS: Students may earn credits by passing MOOCS as decided by the college from time to time. Graduate level programs may award Honors degree provided students earn earn pre-requisite credits through MOOCs

7. Special Guest Lectures (SGL) & Extra Mural Lectures (EML): Some topics/concepts need extra attention and efforts as they either may be high in difficulty level or requires experts from specific industry/domain to make things/concepts clear for a better understanding from the perspective of the industry. Hence, to cater to the present needs of industry we organize such lectures, as part of lecture-series and invite prominent personalities from academia and industry from time to time to deliver their vital inputs and insights.

8. Student Development Programs (SDP): Harnessing and developing the right talent for the right industry an overall development of a student is required. Apart from the curriculum teaching various student development programs (training programs) relating to soft skills, interview skills, Reasoning and Aptitude etc. that may be required as per the need of the student and industry trends, are conducted across the whole program. Participation in such programs is solicited through volunteering and consensus.

9. Industry Focused programs: Establishing collaborations with various industry partners to deliver the programme on sharing basis. The specific courses are to be delivered by industry experts to provide practice based insight to the students.

10. Special assistance programe for slow learners & fast learners: write the note how would you identify slow learners, develop the mechanism to correcting knowledge gap. Terms of advance topics what learning challenging it will be provided to the fast learners.

11. Orientation program:

Purpose of the Student Orientation Program is to help new students adjust and feel comfortable in the new environment, inculcate in them the ethos and culture of the institution, help them build bonds with other students and faculty members, and expose them to a sense of larger purpose and self-exploration. The term induction is generally used to describe the whole process whereby the incumbents adjust to or acclimatize to their new roles and environment. In other words, it is a well-planned event to educate the new entrants about the environment in a particular institution, and connect them with the people in it. Student Orientation Program engages with the new students as soon as they come into the institution; regular classes start only after that. At the start of the induction, the incumbents learn about the institutional policies, processes, practices, culture and values, and their mentor groups are formed.

The time during the Orientation Program is also used to rectify some critical lacunas, for example, English background, for those students who have deficiency in it. These are included under Proficiency Modules. There will be a 3-week long induction program for the UG students entering the institution, right at the start. Normal classes start only after the Orientation program is over. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

Activities to be covered

- Physical Activity
- Creative Arts and Culture
- Mentoring & Universal Human Values
- Familiarization with College, Dept./Branch
- Literary Activity
- Proficiency Modules
- Lectures & Workshops by Eminent People
- Visits in Local Area
- Extra-Curricular Activities in College
- Feedback and Report on the Program

12. **Mentoring scheme:** Every Student shall be provided with a faculty Mentor to help him /her in their personal & Academic Issues. The mentor maintains a register of al all his/her mentees with complete personal & parents 'details. It is essential to have at least to meet once in a month. The mentor enters the discussions held, advice given and efforts & improvements made by the mentee. This register of the mentor must be counter signed by the HOD once a month and by the Principal once in a semester

13. **Career & personal counseling:** Students in college, need to career & personal counseling, who are still confused about what they want to do. Career Counselling helps them understand the career options that they have, and how to pursue them. Career Counselling helps them understand their own strengths and weaknesses and lets them know what career they would be suited for.

14. **Competitive exam preparation**: Unlike school or college academic tests, competitive exams require a different approach, a focused mindset, and a thorough understanding of subjects and concepts. University or Department help students about the exam the pattern, stages and the competition. Department conduct various exam preparation activity for students.

15. **Extracurricular Activities:** Organizing & participation in extracurricular activities will be mandatory to help students develop confidence & face audience with care. It brings out their leadership qualities along with planning & organizing skills. Students undertake various cultural, sports and other competitive activities within and outside then campus. This helps them build their wholesome personality.

16. **Participation in Workshops, Seminars & writing & Presenting Papers:** Seminars and Workshops is also common when participating in extra-curricular academic and students' union activities. Seminar and Workshop is highly interactive, engaging and productive; designed to enhance both individual and group learning processes. Paper writing and research help student to develop abstract thinking and personal or professional growth.

17. **Formation of Student Clubs, Membership & Organizing & Participating events:** A club is "a group of students organized with a similar interest for a social, literary, technical, athletic, political, or other common purpose. Students have the opportunity and choose to join these groups for many reasons including: pursuit of individual interests; career networking opportunities; social camaraderie; and technical activisms.

18. **Capability Enhancement & Development Schemes:** The University has these schemes to enhance the capability and holistic development of the students. The **capability enhancement** and **development schemes** are the stimulating factors in getting the **students** corporate-ready and become a responsible social citizen. To enhance the soft skills and employability skills of the students value added courses such as Communication Skills, Business Communication and Personality Enhancement are made an integral part of the curriculum of the students.

19. **Library Visit & Utilization of E-Learning Resources:** The library is the center of the intellectual and social activities of college. With its books suited to the interests and aptitude of students of different age group, with its magazines, periodicals and newspapers, it has a special call to the students who go there and quench their thirst for reading the material which cannot be provided to them in the class room. Today E-learning

is a rapidly growing industry. Today's learners want relevant, mobile, self-paced, and personalized content. This need is fulfilled with the online mode of learning. E-learning offers the ability to share material in all kinds of formats such as videos, slideshows, word documents, and PDFs. Conducting webinars (live online classes) and communicating with professors via chat and message forums is also an option available to students.

Study & Evaluation Scheme
Program: B. Tech. CS&E (Specialization in DS)
SEMESTER – I

S. No.	Course Category	Course Code	Course Title	Periods			Credits	Evaluation Scheme		
				L	T	P		Internal	External	Total
1	BSC	EAS116	Engineering Mathematics-I	3	1	0	4	40	60	100
2	BSC	EAS112	Engineering Physics	3	1	0	4	40	60	100
		EAS113	Engineering Chemistry							
3	ESC	EEE117	Basic Electrical Engineering	3	1	0	4	40	60	100
		EEC111	Basic Electronics Engineering							
4	MC	TMU101	Environmental Studies	2	1	0	3	40	60	100
5	HSMC	TMUGE101	English Communication – I	2	0	2	3	40	60	100
6	ESC	IDS101	Web Designing	2	0	2	3	40	60	100
7	LC	EAS162	Engineering Physics (Lab)	0	0	2	1	50	50	100
		EAS163	Engineering Chemistry (Lab)							
8	LC	EEE161	Basic Electrical Engineering (Lab)	0	0	2	1	50	50	100
		EEC161	Basic Electronics Engineering (Lab)							
9	LC	EME161	Engineering Drawing (Lab)	0	0	4	2	50	50	100
		EME162	Workshop Practice (Lab)							
	Total			**15**	**4**	**12**	**25**	**390**	**510**	**900**

SEMESTER - II

S. No.	*Course Category*	*Course Code*	*Course Title*	*Periods*			Credits	*Evaluation Scheme*		
				L	*T*	*P*		*Internal*	*External*	*Total*
1	BSC	EAS211	Engineering Mathematics-II	3	1	0	4	40	60	100
2	BSC	EAS212	Engineering Physics	3	1	0	4	40	60	100
		EAS213	Engineering Chemistry							
3	ESC	EEE217	Basic Electrical Engineering	3	1	0	4	40	60	100
		EEC211	Basic Electronics Engineering							
4	ESC	IDS201	Programming in C	3	0	0	3	40	60	100
5	HSMC	TMUGE201	English Communication – II	2	0	2	3	40	60	100
6	LC	EAS262	Engineering Physics (Lab)	0	0	2	1	50	50	100
		EAS262	Engineering Chemistry (Lab)							
7	LC	EEE261	Basic Electrical Engineering (Lab)	0	0	2	1	50	50	100
		EEC261	Basic Electronics Engineering (Lab)							
8	LC	EME161	Engineering Drawing (Lab)	0	0	4	2	50	50	100
		EME162	Workshop Practice (Lab)							
9	LC	IDS251	Programming in C (Lab)	0	0	2	1	50	50	100
	Total			**14**	**3**	**12**	**23**	**400**	**500**	**900**

SEMESTER III

S. No.	Course Category	Course Code	Course Title	Periods			Credits	Evaluation Scheme		
				L	T	P		Internal	External	Total
1	PCC	IDS301	Introduction to Data Science	3	0	0	3	40	60	100
2	PCC	IDS302	Statistics and Probability	2	1	0	3	40	60	100
3	PCC	IDS303	Data Structures Using C++	3	0	0	3	40	60	100
4	PCC	IDS304	Computer Architecture and Organizations	3	0	0	3	40	60	100
5	PCC	IDS305	OOPS with Java	3	0	0	3	40	60	100
6	HSMC	IDS306	Effective Communication Skills	1	0	2	2	40	60	100
7	LC	IDS351	Data Structures Using C++ (Lab)	0	0	4	2	50	50	100
8	LC	IDS 352	OOPS with Java (Lab)	0	0	4	2	50	50	100
9	PROJ	IDS353	Project	0	0	2	1	50	50	100
	Total			**15**	**1**	**12**	**22**	**390**	**510**	**900**

Additional Courses for Lateral Entry Students with Polytechnic/B.Sc background, to be taken in either IIIrd or IVth semester or all should pass with minimum of 40% marks if they have not taken these courses in their Polytechnic/B.Sc dgree: credits will not be added.

1	EME161/261	Engineering Drawing Lab	-	-	2	50	50	100
2	EME162/262	Workshop Practice (Lab)	-	-	2	50	50	100
3	TMU101	Environmental Studies	2	0	0	40	60	100

Value Added Course*

S.No.	Course Category	Course Code	Course Name	Periods			Credits	Evaluation		
				L	T	P		Internal	External	Total
1	VAC-I	TMUGA301	Foundation in Quantitative Aptitude	2	1	0	0	40	60	100

*Value Added Courses (VAC) is an audit course. The result of this course will not be added to overall result of the programme. However, it will be compulsory to pass the course with minimum 45% including both faculty continuous & end semester examination.

SEMESTER IV

S. No.	Course Category	Course Code	Course Title	Periods			Credits	Evaluation Scheme		
				L	T	P		Inter-nal	Exter-nal	Total
1	PCC	IDS401	Python Programming for Data Science	3	0	0	3	40	60	100
2	PCC	IDS402	Sampling Methods	3	0	0	3	40	60	100
3	PCC	IDS403	Relational Database Management System	3	0	0	3	40	60	100
4	PCC	IDS404	Operating System	3	0	0	3	40	60	100
5	HSMC	IDS405	Personality Development	2	0	2	3	40	60	100
6	LC	IDS451	Relational Database Management System (Lab)	0	0	4	2	50	50	100
7	LC	IDS452	Python Programming for Data Science (Lab)	0	0	4	2	50	50	100
8	PEC	-	**Professional Elective Courses-I**	3	0	0	3	40	60	100
	Total			**17**	**0**	**10**	**22**	**340**	**460**	**800**
****Industrial Training**										

Value Added Course*

S.N	Category code	Course Code	Course Name	Periods			Credits	Evaluation Scheme		
				L	T	P		Internal	External	Total
1	VAC-II	TMUGA401	Analytical Reasoning	2	1	0	0	40	60	100

**At the end of Semester-IV Industrial Training for at least 45 days is mandatory which is to be assessed and evaluated in Semester-V under subject code IDS553 (Industrial Training Seminar).

SEMESTER V

S. No.	Course Category	Course Code	Course Title	Periods			Credits	Evaluation Scheme		
				L	T	P		Internal	External	Total
1	PCC	IDS501	Data Mining Techniques	3	0	0	3	40	60	100
2	PCC	IDS502	NoSQL Databases	3	0	0	3	40	60	100
3	PCC	IDS503	Software Engineering	3	0	0	3	40	60	100
4	PCC	IDS504	Computer Networks	3	0	0	3	40	60	100
5	PCC	IDS505	Theory of Computation	3	0	0	3	40	60	100
6	HSMC	EHM501	HUMAN VALUES & PROFESSIONAL ETHICS	3	0	0	3	40	60	100
7	LC	IDS551	Data Mining Techniques (Lab)	0	0	4	2	50	50	100
8	LC	IDS552	NoSQL Databases (Lab)	0	0	4	2	50	50	100
9	PROJ	IDS553	Industrial Training Seminar	0	0	2	1	50	50	100
10	PEC	-	**Professional Elective Courses-II**	3	0	2	4	40	60	100
	Total			**21**	**0**	**12**	**27**	**430**	**570**	**1000**

Value Added Course*

S.N	Category code	Course Code	Course Name	Periods			Credit	Evaluation Scheme		
				L	T	P		Internal	External	Total
1	VAC-III	TMUGA501	Modern Algebra and Data Management	2	1	0	0	40	60	100
2	VAC-IV	TMUGS501	Managing Self	2	1	0	0	50	50	100

Campus Recruitment Training (CRT)**

S.N	Category code	Course Code	Course Name	Periods			Credits	Evaluation Scheme		
				L	T	P		Internal	External	Total
1	CRT	CRT-I	Campus Recruitment Training	1	0	0	0	0	0	0

** Campus Recruitment Training Program comprises of technical subjects, aptitude (company specific), HR and soft-skills training modules.

SEMESTER VI

S. No.	Course Category	Course Code	Course Title	Period			Credits	Evaluation Scheme		
				L	T	P		Internal	External	Total
1	PCC	IDS601	Big Data Analytics	3	0	0	3	40	60	100
2	PCC	IDS602	Time Series Forecasting	3	0	0	3	40	60	100
3	PCC	IDS603	Inferential Statistics	3	0	0	3	40	60	100
4	PCC	IDS604	Design and Analysis of Algorithms	3	0	0	3	40	60	100
5	HSMC	IDS605	Logical Reasoning and Thinking	2	0	0	2	40	60	100
6	LC	IDS651	Design and Analysis of Algorithms (Lab)	0	0	4	2	50	50	100
7	LC	IDS652	Big Data Analytics (Lab)	0	0	4	2	50	50	100
8	PEC	-	**Professional Elective Courses-III**	3	0	0	3	40	60	100
9	PEC	-	**Professional Elective Courses-IV**	3	0	0	3	40	60	100
	Total			**20**	**0**	**8**	**24**	**380**	**520**	**900**
****Industrial Training**										

Value Added Course*

S. N	Category code	Course Code	Course Name	Periods			Credits	Evaluation		
				L	T	P		Internal	External	Total
1	VAC-V	TMUGA601	Advance Algebra and Geometry	2	1	0	0	40	60	100
2	VAC-VI	TMUGS601	Managing Work and Others	2	1	0	0	50	50	100

Campus Recruitment Training (CRT)-Including Mock Interview***

S.N	Category code	Course Code	Course Name	Periods			Credits	Evaluation Scheme		
				L	T	P		Internal	External	Total
1	CRT	CRT-I	Campus Recruitment Training	2	0	0	0	0	0	0

**At the end of Semester-VI Industrial Training for at least 45 days is mandatory which is to be assessed and evaluated in Semester-VII under subject code IDS754 (Industrial Training Seminar).

SEMESTER VII

S. No.	Course Category	Course Code	Course Title	Periods			Credits	Evaluation Scheme		
				L	T	P		Internal	External	Total
1	PCC	IDS701	Advanced Big Data Analytics	3	0	0	3	40	60	100
2	PCC	IDS702	Machine Learning	3	0	0	3	40	60	100
3	PCC	IDS703	Model Validation Techniques	3	0	0	3	40	60	100
4	LC	IDS751	Advanced Big Data Analytics (Lab)	0	0	4	2	50	50	100
5	LC	IDS752	Machine Learning (Lab)	0	0	2	1	50	50	100
6	PROJ	IDS753	Mini Project (Lab)	0	0	2	1	50	50	100
7	PROJ	IDS754	Industrial Training Seminar	0	0	2	1	50	50	100
8	PEC	-	**Professional Elective Courses-V**	2	1	0	3	40	60	100
9	PEC	-	**Professional Elective Courses-VI**	2	1	0	3	40	60	100
10	OEC	-	**Open Elective Courses - I**	3	0	0	3	40	60	100
	Total			**16**	**2**	**10**	**23**	**440**	**560**	**1000**

SEMESTER VIII

S. No.	Course Category	Course Code	Course Title	Periods			Credits	Evaluation Scheme		
				L	T	P		Internal	External	Total
1	PROJ	IDS851	Industry Internship	0	0	20	10	100	100	200
2	PROJ	IDS852	MOOC – Professional Certification Course based on Data Science	0	0	8	4	50	50	100
			Total	0	0	28	14	150	150	300
OR										
1	PROJ	IDS851	Project	0	0	16	8	50	50	100
2	PEC	-	**Professional Elective Courses-VII**	3	0	0	3	40	60	100
3	OEC	-	**Open Elective Courses – II**	3	0	0	3	40	60	100
	Total			**6**	**0**	**16**	**14**	**130**	**170**	**300**

Semester Wise Groups of Professional Elective Courses (PEC):

SEMESTER-IV
PROFESSIONAL ELECTIVE COURSES-I (Select any one)
(Select any one course from group no.1 given below)

S. No.	Course Category	Course Code	Course Title
1	PEC	IDS406	Exploratory Data Analysis
		IDS407	Sampling Techniques
		IDS408	Data Aggregation and Preprocessing

SEMESTER-V
PROFESSIONAL ELECTIVE COURSES-II (Select any one)
(Select any one course from group no.1 given below)

S. No.	Course Category	Course Code	Course Title
1	PEC	IDS506	Data Analytics using SQL
		IDS507	Data Analytics using Excel
		IDS508	R Programming

SEMESTER-VI
PROFESSIONAL ELECTIVE COURSES - III (Select any one)
(Select any one course from group no.1 given below)

S. No.	Course Category	Course Code	Course Title
1	PEC	IDS606	Internet of Things
		IDS607	Artificial Intelligence
		IDS608	Cloud Computing

PROFESSIONAL ELECTIVE COURSES - IV (Select Any One)
(Select any one course from group no.2 given below)

S. No.	Course Category	Course Code	Course Title
2	PEC	IDS609	Block chain Fundamentals
		IDS610	Intelligent Process Automation Fundamentals
		IDS611	Recommender System

SEMESTER-VII
PROFESSIONAL ELECTIVE COURSES– V (Select any one)
(Select any one course from group no.1 given below)

S. No.	Course Category	Course Code	Course Title
1	PEC	IDS704	Predictive Analytics
		IDS705	Social Media Analytics
		IDS706	Pattern Recognition

PROFESSIONAL ELECTIVE COURSES – VI (Select any one)
(Select any one course from group no.2 given below)

S. No.	Course Category	Course Code	Course Title
2	PEC	IDS707	Business Intelligence
		IDS708	Data Visualization
		IDS709	Design Thinking

SEMESTER-VIII
PROFESSIONAL ELECTIVE COURSES – VII
(Select any one course from group no.1 given below)

S. No.	Course Category	Course Code	Course Title
1	PEC	IDS801	Reinforcement Learning
		IDS802	Econometrics
		IDS803	Cloud for ML

Course Code: EAS116	**Specialization- Data Science** **B.Tech.- Semester-I** **Engineering Mathematics-I**	**L-3 T-1 P-0 C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	***Understanding*** the concepts of eigenvalues and eigenvectors, Optimization & derivatives of functions of several variables, partial and total differentiation, implicit functions.	
CO2.	***Understanding*** the concepts of curl and divergence of vector field.	
CO3.	***Understanding*** of Green's theorem, Gauss Theorem, and Stokes theorem.	
CO4.	***Applying*** the concept of Leibnitz's theorem for successive derivatives.	
CO5.	***Analyzing*** the intangibility of a differential equation to find the optimal solution of first order first degree equations.	
CO6.	***Evaluating*** the double integration and triple integration using Cartesian, polar co-ordinates and the concept of Jacobian of transformation.	
Course Content:	**Unit A (Unit A is for building a foundation and shall not be a part of examination)** Some general theorem on deviation-Derivative of the sum or difference of two function, Derivative of product of two functions, Derivative of quotient, Derivative of Trigonometry function, Derivative of inverse Trigonometry function, Logarithms differential, Integration of 1/x, e^x, Integration by simple substitution. Integrals of the type f' (x), $[f(x)]^n$, $\frac{f'(x)}{f(x)}$, Integration of 1/x, e^x, tan x, cot x, sec x, cosec x , Integration by parts, Integration using partial fractions.	
Unit-1:	**Determinants**- Rules of computation; Linear Equations and Cramer's rule. **Matrices:** Elementary row and column transformation; Rank of matrix; Linear dependence; Consistency of linear system of equations; Characteristic equation; Cayley-Hamilton Theorem (without proof); Eigen values and Eigen vectors; Complex and Unitary matrices.	**8 Hours**
Unit-2:	**Differential Equation**--First order first degree Differential equation: variable separable, Homogeneous method, Linear differential equation method, Exact Differential equation.	**8 Hours**
Unit-3:	**Differential Calculus:** Leibnitz theorem; Partial differentiation; Euler's theorem; Change of variables; Expansion of function of several variables. Jacobians, Error function.	**8 Hours**
Unit-4:	**Multiple Integrals:** Double integral, Triple integral, Beta and Gamma functions; Dirichlet theorem for three variables, Liouville's Extension of Dirichlet theorem.	**8 Hours**
Unit-5:	**Vector Differentiation:** Vector function, Differentiation of vectors, Formulae of Differentiation, Scalar and Vector point function, Geometrical Meaning of Gradient, Normal and Directional Derivative, Divergence of a vector function, Curl of a vector **Vector Integration:** Green's theorem, Stokes' theorem; Gauss' divergence theorem.	**8 Hours**
Text Books:	1. Grewal B.S., *Higher Engineering Mathematics*, Khanna Publishers.	
Reference Books:	1. Kreyszig E., *Advanced Engineering Mathematics*, Wiley Eastern. 2. Piskunov N, *Differential & Integral Calculus*, Moscow Peace Publishers. 3. Narayan Shanti, *A Text book of Matrices*, S. Chand 4. Dass H.K., Engineering Mathematics Vol-I, S. Chand. *** Latest editions of all the suggested books are recommended.**	

Additional electronic reference material:	1. https://www.youtube.com/watch?v=EGnI8WyYb3o 2. https://www.youtube.com/watch?v=ksS_yOK1vtk&list=PLbRMhDVUMngfIrZCNOyPZwHUU1pP66vQW	

Course Code: EAS112	**Specialization- Data Science** **B.Tech.- Semester-I** **Engineering Physics**	**L-3 T-1 P-0 C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** the basic concepts of interference, diffraction and polarisation.	
CO2.	**Understanding** the concept of bonding in solids and semiconductors.	
CO3.	**Understanding** the special theory of relativity.	
CO4.	**Applying** special theory of relativity to explain the phenomenon of length contraction, time dilation, mass-energy equivalence etc.	
CO5.	**Applying** the concepts of polarized light by the Brewster's and Malus Law	
Course Content:	**Unit A(Unit A is for building a foundation and shall not be a part of examination)** Optics- Properties of light, Lance, Mirror, Focal length, Intensity, Power, Eye-piece, Work, Energy and its types, Waves, longitudinal and transverse waves, Time period, Frequency	
Unit-1:	**Interference of Light:** Introduction,Principle of Superposition, Interference due to division of wavefront: Young's double slit experiment, Theory of Fresnel's Bi-Prism, Interference due to division of amplitude: parallel thin films, Wedge shaped film, Michelson's interferometer, Newton's ring.	**8 Hours**
Unit-2:	**Diffraction**: Introduction, Types of Diffraction and difference between them, Condition for diffraction, difference between interference and diffraction. **Single slit diffraction**: Quantitative description of maxima and minima with intensity variation, linear and angular width of central maxima. **Resolving Power**: Rayleigh's criterion of resolution, resolving power of diffraction grating and telescope.	**8 Hours**
Unit-3:	**Polarization:** Introduction, production of plane polarized light by different methods, Brewster's and Malus Law. Quantitative description of double refraction, Nicol prism, Quarter & half wave plate, specific rotation, Laurent's half shade polarimeter.	**8 Hours**
Unit-4:	**Elements of Material Science:** Introduction, Bonding in solids, Covalent bonding and Metallic bonding, Classification of Solids as Insulators, Semi-Conductor and Conductors, Intrinsic and Extrinsic Semiconductors, Conductivity in Semiconductors, Determination of Energy gap of Semiconductor. **Hall Effect:** Theory, Hall Coefficients and application to determine the sign of charge carrier, Concentration of charge carrier, mobility of charge carriers.	**8 Hours**
Unit-5:	**Special Theory of Relativity:** Introduction, Inertial and non-inertial frames of Reference, Postulates of special theory of relativity, Galilean and Lorentz Transformations, Length contraction and Time Dilation, Relativistic addition of velocities, Variation of mass with velocity, Mass-Energy equivalence.	**8 Hours**
Text Books:	1. Elements of Properties of Matter, D. S. Mathur, S. Chand & Co.	
Reference Books:	1. F. A. Jenkins and H. E. White, Fundamentals of Optics, McGraw-Hill. 2. Concept of Modern Physics, Beiser, Tata McGraw-Hill. 3. R. Resnick, Introduction to Special Relativity, John Wiley, Singapore. *** Latest editions of all the suggested books are recommended.**	
Additional electronic reference material:	**1.** https://www.youtube.com/watch?v=toGH5BdgRZ4&list=PLD9DDFBDC338226CA **2.** https://www.youtube.com/watch?v=CuqsU7B1MtU	

Course Code: **EAS113**	**Specialization- Data Science** **B.Tech.- Semester-I** **Engineering Chemistry**	**L-3 T-1 P-0 C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** the concept of softening & purification of water.	
CO2.	**Understanding** calorific value& combustion, analysis of coal, Physical & Chemical properties of hydrocarbons & quality improvements.	
CO3.	**Understanding** the concept of lubrication, Properties of Refractory & Manufacturing of cements.	
CO4.	**Applying** the concepts of the mechanism of polymerization reactions, Natural and synthetic rubber& vulcanization.	
CO5.	**Applying** the concepts of spectroscopic & chromatographic techniques.	
Course Content:		
Unit-1:	**Water and Its Industrial Applications:** Sources, Impurities, Hardness and its units, Industrial water, characteristics, softening of water by various methods (External and Internal treatment), Boiler trouble causes effects and remedies, Characteristic of municipal water and its treatment, Numerical problem based on water softening method like lime soda, calgon etc.	**8 Hours**
Unit-2:	**Fuels and Combustion:** Fossil fuel and classification, calorific value, determination of calorific value by Bomb and Jumker's calorimeter, proximate and ultimate analysis of coal and their significance, calorific value computation based on ultimate analysis data, Combustion and its related numerical problems carbonization manufacturing of coke, and recovery of byproduct, knocking relationship between knocking and structure and hydrocarbon, improvement ant knocking characteristic IC Engine fuels, Diesel Engine fuels, Cetane Number.	**8 Hours**
Unit-3:	**Lubricants:** Introduction, mechanism of lubrication, classification of lubricant, properties and testing of lubricating Oil Numerical problem based on testing methods. Cement and Refractories: Manufacture, IS code, Setting and hardening of cement, Portland cement Plaster of Paris, Refractories. Introduction, classification and properties of refractories.	**8 Hours**
Unit-4:	**Polymers:** Introduction, types and classification of polymerization, reaction mechanism, Natural and synthetic rubber, Vulcanization of rubber, preparation, properties and uses of the following Polythene, PVC, PMMA, Teflon, Polyacrylonitrile, PVA, Nylon 6, Terylene, Phenol Formaldehyde, Urea Formaldehyde Resin, Glyptal, Silicones Resin, Polyurethanes, Butyl Rubber, Neoprene, Buna N, Buna S.	**8 Hours**
Unit-5:	**A. Instrumental Techniques in chemical analysis:** Introduction, Principle, Instrumentation and application of IR, NMR, UV, Visible, Gas Chromatography, Lambert and Beer's Law. **B. Water Analysis Techniques:** Alkalinity, Hardness (Complexometric), Chlorides, Free Chlorine, DO, BOD, and COD, Numerical Problem Based on above techniques.	**8 Hours**
Text Books:	1. Agarwal R. K., Engineering Chemistry, Krishna Prakashan.	
Reference Books:	1. Morrison & Boyd, Organic Chemistry, Prentice Hall 2. Barrow Gordon M., Physical Chemistry, McGraw-Hill. 3. Chawla Shashi, Engineering Chemistry, Dhanpat Rai Publication. *** Latest editions of all the suggested books are recommended.**	

Additional electronic reference material:	1. https://www.youtube.com/watch?v=RV-OyRTaIOI 2. https://www.youtube.com/watch?v=phhfkikb6Lw	

Course Code: **EEE117**	**Specialization- Data Science** **B.Tech.- Semester-I** **Basic Electrical Engineering**	**L-3 T-1 P-0 C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** the basics of Network, AC Waveform and its characteristics.	
CO2.	**Understanding** the basic concept of Measuring Instruments, Transformers & three phase Power systems.	
CO3.	**Understanding** the basic concepts of Transformer.	
CO4.	**Understanding** the basic concept of power measurement using two wattmeter methods.	
CO5.	**Applying** the concept of Kirchhoff's laws and Network Theorems to analyze complex electrical circuits.	
Course Content:		
Unit-1:	**D.C. Network Theory:** Passive, active, bilateral, unilateral, linear, nonlinear element, Circuit theory concepts-Mesh and node analysis; Voltage and current division, source transformation, Network Theorems-Superposition theorem, Thevenin's theorem, Norton's theorem, and Maximum Power Transfer theorem, Star-delta & delta-star conversion.	**8 Hours**
Unit-2:	**Steady State Analysis of A.C. Circuits:** Sinusoidal and phasor representation of voltage and Current; Single phase A.C. circuit behavior of resistance, inductance and capacitance and their Combination in series & parallel; Power factor; Series and parallel resonance; Band width and Quality factor.	**8 Hours**
Unit-3:	**Basics of Measuring Instruments:** Introduction to wattmeter & Energy meter extension range of voltmeter and ammeter. **Three Phase A.C. Circuits:** Line and phase voltage/current relations; three phase power, power measurement using two wattmeter methods.	**8 Hours**
Unit-4:	**Single phase Transformer:** Principle of operation; Types of construction; Phasor diagram; Equivalent circuit; Efficiency and losses.	**8 Hours**
Unit-5:	**Electrical machines:** DC machines: Principle & Construction, Types, EMF equation of generator and torque equation of motor, applications of DC motors (simple numerical problems)	**8 Hours**
Text Books:	1. V. Del Toro, Principles of Electrical Engineering, Prentice-Hall International.	
Reference Books:	1. Fitzgerald A.E & Higginbotham., D.E., Basic Electrical Engineering, McGraw Hill. 2. A Grabel, Basic Electrical Engineering, McGraw Hill. 3. Cotton H., Advanced Electrical Technology, Wheeler Publishing. 4. Nagrath I.J., Basic Electrical Engineering, Tata McGraw Hill. *** Latest editions of all the suggested books are recommended.**	
Additional electronic reference material:	• https://nptel.ac.in/courses/108/108/108108076/ • https://sites.google.com/tmu.ac.in/dr-garima-goswami/home	

Course Code: **EEC111**	**Specialization- Data Science** **B.Tech.- Semester-I** **Basic Electronics Engineering**	**L-3** **T-1** **P-0** **C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** the concepts of electronic components like diode, BJT & FET.	
CO2.	**Understanding** the applications of pn junction diode as clipper, clamper, rectifier & regulator whereas BJT & FET as amplifiers	
CO3.	**Understanding** the functions and applications of operational amplifier-based circuits such as differentiator, integrator, and inverting, non-inverting, summing & differential amplifier.	
CO4.	**Understanding** the concepts of number system, Boolean algebra and logic gates.	
CO5.	**Applying** the knowledge of series, parallel and electromagnetic circuits.	
Course Content:		
Unit-1:	**p-n Junction:** Energy band diagram in materials, Intrinsic & Extrinsic Semiconductor, Introduction to PN-Junction, Depletion layer, V-I characteristics, p-n junction as rectifiers (half wave and full wave), calculation of ripple factor of rectifiers, clipping and clamping circuits, Zener diode and its application as shunt regulator.	**8 Hours**
Unit-2:	**Bipolar Junction Transistor (BJT):** Basic construction, transistor action; CB, CE and CCconfigurations, input/output characteristics, Relation between α, β & γ, Biasing of transistors: Fixed bias, emitter bias, potential divider bias.	**8 Hours**
Unit-3:	**Field Effect Transistor (FET):** Basic construction of JFET; Principle of working; concept of pinch-off condition & maximum drain saturation current; input and transfer characteristics; Characteristics equation; fixed and self-biasing of JFET amplifier; Introduction of MOSFET; Depletion and Enhancement type MOSFET- Construction, Operation and Characteristics.	**8 Hours**
Unit-4:	**Operational Amplifier (Op-Amp):** Concept of ideal operational amplifier; ideal and practical Op-Amp parameters; inverting, non-inverting and unity gain configurations, Applications of Op-Amp as adders, difference amplifiers, integrators and differentiator.	**8 Hours**
Unit-5:	**Switching Theory:** Number system, conversion of bases (decimal, binary, octal and hexadecimalnumbers), Addition & Subtraction, BCD numbers, Boolean algebra, De Morgan's Theorems, Logic gates and truth table- AND, OR & NOT,Seven segment display & K map.	**8 Hours**
Text Books:	1. Robert Boylestad & Louis Nashelsky, Electronic Circuit and Devices, Pearson India.	
Reference Books:	1. Sedra and Smith, Microelectronic Circuits, Oxford University Press. 2. Gayakwad, R A, Operational Amplifiers and Linear Integrated circuits, Prentice Hall of India Pvt. Ltd. 3. Chattopadhyay D and P C Rakshit, Electronics Fundamentals and Applications, New Age International. 4. Millman & Halkias, Integrated Electronics, McGraw Hill. *** Latest editions of all the suggested books are recommended.**	
Additional electronic reference material:	1. https://www.youtube.com/watch?v=USrY0JspDEg 2. https://www.youtube.com/watch?v=Hkz27cFW4Xs	

Course Code: **TMU101**	**Specialization- Data Science** **B.Tech.- Semester-I** **Environmental Studies**	**L-2** **T-1** **P-0** **C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** environmental problems arising due to constructional and developmental activities.	
CO2.	**Understanding** the natural resources and suitable methods for conservation of resources for sustainable development.	
CO3.	**Understanding** the importance of ecosystem and biodiversity and its conservation for maintaining ecological balance.	
CO4.	**Understanding** the types and adverse effects of various environmental pollutants and their abatement devices.	
CO5.	**Understanding** Greenhouse effect, various Environmental laws, impact of human population explosion, environment protection movements, different disasters and their management.	
Course Content:		
Unit-1:	***Definition and Scope*** of environmental studies, multidisciplinary nature of environmental studies, concept of sustainability & sustainable development. ***Ecology and Environment:*** Concept of an Ecosystem- its structure and functions, Energy Flow in an Ecosystem, Food Chain, Food Web, Ecological Pyramid & Ecological succession, Study of following ecosystems: Forest Ecosystem, Grass land Ecosystem & Aquatic Ecosystem & Desert Ecosystem.	**8 Hours**
Unit-2:	***Natural Resources:*** Renewable & Non-Renewable resources; Land resources and landuse change; Land degradation, Soil erosion & desertification. Deforestation: Causes & impacts due to mining, Dam building on forest biodiversity & tribal population. Energy Resources: Renewable & Non-Renewable resources, Energy scenario & use of alternate energy sources, Case studies. Biodiversity: Hot Spots of Biodiversity in India and World, Conservation, Importance and Factors Responsible for Loss of Biodiversity, Biogeographical Classification of India	**8 Hours**
Unit-3:	***Environmental Pollutions:*** Types, Causes, Effects & control; Air, Water, soil & noise pollution, Nuclear hazards & human health risks, Solid waste Management; Control measures of urban & industrial wastes, pollution case studies.	**8 Hours**
Unit-4:	***Environmental policies & practices:*** Climate change & Global Warming (Greenhouse Effect), Ozone Layer - Its Depletion and Control Measures, Photochemical Smog, Acid Rain Environmental laws: Environment protection Act; air prevention & control of pollution act, Water Prevention & Control of Pollution Act, Wild Life Protection Act, Forest Conservation Acts, International Acts; Montreal & Kyoto Protocols & Convention on biological diversity, Nature reserves, tribal population & Rights & human wild life conflicts in Indian context	**8 Hours**
Unit-5:	***Human Communities & Environment:***Human population growth; impacts on environment, human health & welfare, Resettlement & rehabilitation of projects affected person: A case study, Disaster Management; Earthquake, Floods & Droughts, Cyclones & Landslides, Environmental Movements; Chipko, Silent Valley, Vishnoi's of Rajasthan, Environmental Ethics; Role of Indian & other regions & culture in environmental conservation, Environmental communication & public awareness; Case study	**8 Hours**

	Field Work: 1. Visit to an area to document environmental assets; river/forest/flora-fauna etc. 2. Visit to a local polluted site: urban/ rural/industrial/agricultural. 3. Study of common plants, insects, birds & basic principles of identification. 4. Study of simple ecosystem; pond, river etc.	
Text Books:	1. "Introduction to Environmental Engineering and Science", Masters, G. M., Prentice Hall India Pvt. Ltd.	
Reference Books:	1. "Biodiversity and Conservation", Bryant, P. J., Hypertext Book 2. "Textbook of Environment Studies", Tewari, Khulbe & Tewari, I.K. Publication 3. "Environmental Chemistry", De, A. K., New Age Publishers Pvt. Ltd. 4. "Fundamentals of Ecology", Odem, E. P., W. B. Sannders Co. *** Latest editions of all the suggested books are recommended.**	
Additional electronic reference material:	1. https://www.youtube.com/watch?v=8tamfocnHb8 2. https://www.youtube.com/watch?v=YlE1DDo25IQ	

Course Code: **TMUGE101**	**Specialization- Data Science** **B.Tech.- Semester-I** **English Communication – I**	**L-2 T-0 P-2 C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Remembering and understanding of the basic of English grammar and vocabulary.	
CO2.	Understanding of the basic Communication process.	
CO3.	Applying correct vocabulary and tenses in sentences construction.	
CO4.	Analyzing communication needs and developing communication strategies using both verbal & non-verbal method.	
CO5.	Drafting applications in correct format for common issues.	
CO6.	Developing self-confidence.	
Course Content:		
Unit-1:	**Introductory Session** • Self-Introduction • Building Self Confidence: Identifying strengths and weakness, reasons of Fear of Failure, strategies to overcome Fear of Failure • Importance of English Language in present scenario (*Practice: Self-introduction session)*	**6 Hours**
Unit-2:	**Basics of Grammar** • Parts of Speech • Tense • Subject and Predicate • Vocabulary: Synonym and Antonym *(Practice: Conversation Practice)*	**12 Hours**
Unit-3:	**Basics of Communication** • Communication : Process, Types, 7Cs of Communication, Importance & Barrier • Language as a tool of communication • Non-verbal communication: Body Language • Etiquette & Manners • Basic Problem Sounds *(Practice: Pronunciation drill and building positive body language)*	**10 Hours**
Unit-4:	**Application writing** • Format & Style of Application Writing • Practice of Application writing on common issues.	**8 Hours**
Unit-5:	**Value based text reading** • Short Story (Non- detailed study) • Gift of Magi – O. Henry	**4 Hours**
Text Books:	1. Singh R.P., An Anthology of Short stories, O.U.P. New Delhi.	
Reference Books:	1. Kumar, Sanjay. &Pushp Lata. "*Communication Skills"* New Delhi: Oxford University Press. 2. Carnegie Dale. "*How to win Friends and Influence People*" New York: Simon & Schuster. 3. Harris, Thomas. A. "*I am ok, You are ok*" New York: Harper and Row. 4. Goleman, Daniel. "*Emotional Intelligence*" Bantam Book. *** Latest editions of all the suggested books are recommended.**	
Additional electronic	**1.** https://www.youtube.com/watch?v=4XEa-8HD3lE	

reference material:	**2.** https://www.youtube.com/watch?v=sb6ZZ2p3hEM&feature=youtu.be **3.** https://www.youtube.com/watch?v=Df3ysUkdB38 **4.** https://www.youtube.com/watch?v=0LdYaj3jcws **5.** https://www.youtube.com/watch?v=64XIkMqPm_8 **6.** https://www.youtube.com/watch?v=_vS6O8YlMq0	

Methodology:

1. Language Lab software.
2. The content will be conveyed through Real life situations, Pair Conversation, Group Talk and Class Discussion.
3. Conversational Practice will be effectively carried out by Face to Face & Via Media (Telephone, Audio-Video Clips)
4. Modern Teaching tools (PPT Presentation, Tongue-Twisters & Motivational videos with sub-titles) will be utilized.

Note:

- Class (above 30 students) will be divided in to two groups for effective teaching.
- For effective conversation practice, groups will be changed weekly.

Evaluation Scheme

Internal Evaluation			**External Evaluation**		**Total Marks**
40 Marks			**60 Marks**		**100**
20 Marks (Best 2 out of Three CTs) ***(From Unit- II, IV & V)***	10 Marks (Oral Assignments) ***(From Unit I & III)***	10 Marks (Attendance)	40 Marks (External Written Examination) ***(From Unit- II, IV & V)***	20 Marks (External Viva)* ***(From Unit I & III)***	

***Parameters of External Viva**

Content	**Body Language**	**Confidence**	**Question Responsiveness**	**TOTAL**
05 Marks	05 Marks	05 Marks	05 Marks	20 Marks

***Note**: External Viva will be conducted by 2-member committee comprising*

a) *One Faculty teaching the class*

b) *One examiner nominated by University Examination cell.*

Each member will evaluate on a scale of 20 marks and the average of two would be the 20 marks obtained by the students.

Course Code: **IDS101**	**Specialization- Data Science** **B.Tech.- Semester-I** **WEB DESIGNING**	**L-2** **T-0** **P-2** **C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the concepts of internet design principles and various protocols which is widely use in the Internet.	
CO2.	Understanding the use of different web development technologies.	
CO3.	Understanding the various HTML tags use in web pages designing.	
CO4.	Understanding the concepts of DOM object model	
CO5.	Applying various web technologies to create interactive web page(s).	
Course Content:		
Unit-1:	**Introduction to Internet:** Introduction, History of internet, Internet Design Principles, Internet Protocols - FTP, TCP/IP, SMTP, Telnet, etc., Client Server Communication, Web System architecture	**8 Hours**
Unit-2:	**Introduction to World Wide Web:** Evolution of Web, Static and Dynamic Web Sites, Web Applications, Web Development Technologies - HTML, CSS, JS, XML; Protocols - HTTP, secure HTTP, etc; URL, Web Browser, Web Server, Web Services	**8 Hours**
Unit-3:	**HTML:** Introduction to Html, Html Document structure, Html Editors, Html element/tag & attributes, Designing simple page - Html tag, Head tag, Body tag; More Html tags - Anchor tag, Image tag, Table tag, List tag, Frame tag, Div tag ; Html forms - Input type, Text area, Select , Button, Images	**8 Hours**
Unit-4:	**CSS:** Introduction to CSS, Syntax, Selectors ,Embedding CSS to Html, Formatting fonts, Text & background colour, Inline styles, External and Internal Style Sheets, Borders & boxing	**8 Hours**
Unit-5:	**XML:** Introduction to XML, Difference b/w Html & XML, XML editors, XML Elements & Attributes XML DTD, XML Schema, XML Parser, Document Object Model (DOM), XML DOM..	**8 Hours**
Text Books:	1. Web Technologies - HTML, JavaScript, PHP, Java, JSP, ASP.NET, XML and Ajax, Black Book, by Dreamtech Press	
Reference Books:	1. HTML, XHTML & CSS Bible, Brian Pfaffenberger, Steven M.Schafer, Charles White, Bill Karow- Wiley Publishing Inc, 2010 2. HTML Black Book by Steven Holzner 3. Web Design with HTML, CSS, JavaScript and jQuery Set by Jon Duckett *** Latest editions of all the suggested books are recommended.**	
E-Content Reference	1. https://www.w3schools.com/html/ 2. https://www.tutorialspoint.com/css/index.htm 3. https://resources.mpi-inf.mpg.de/d5/teaching/ss03/xml-seminar/talks/xml%20for%20beginners.pdf	

LISTOFEXPERIMENTS

1. Design a simple web page with head, body and footer, with heading tags, image tag
2. Design a web site for book information, home page should contain books list, when particular book is clicked, information of the books should display in the next page.
3. Design a page to display the product information such as name, brand, price and etc with table tag
4. Design a web site for book information using frames, home page should contain two parts, left part should contain books list, and right part should contain book information.
5. Design a web page to capture the user information such as name, gender, mobile number, mail id, city, state, and country using form elements.
6. Design a web page with nice formatting like background image, text colors and border for text using external CSS.
7. Design a web page to perform mathematical calculations such as addition, subtraction, multiplication, and division
8. Design a web page to read data from an XML file and display the data in tabular format, take the data as employee information.
9. Design a web site for online purchase using CSS, JS and XML, web site should contain the following web pages.
    - Home page
    - Login page
    - Signup page
    - Product details page

Course Code: **EAS162**	**Specialization- Data Science** **B.Tech.- Semester-I** **Engineering Physics (Lab)**	**L-0** **T-0** **P-2** **C-1**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** of the operation of various models of optical devices.	
CO2.	**Understanding** types of Semiconductors using Hall experiments.	
CO3.	**Applying** the concept of interference, polarization & dispersion in optical devices through Newton's ring, Laser, polarimeter & spectrometer.	
CO4.	**Applying** the concept of resonance to determine the AC frequency using sonometer & Melde's apparatus.	
CO5.	**Applying** the concept of resolving & dispersive power by a prism.	
Course Content:	**Note: Select any ten experiments from the following list.**	
LIST OF EXPERIMENTS	**1.** To determine the wavelength of monochromatic light by Newton's ring. **2.** To determine the wavelength of monochromatic light by Michelson-Morley experiment. **3.** To determine the wavelength of monochromatic light by Fresnel's Bi-prism. **4.** To determine the Planck's constant using LEDs of different colours. **5.** To determine the specific rotation of cane sugar solution using Polarimeter. **6.** To verify Stefan's Law by electrical method. **7.** To study the Hall Effect and determine Hall coefficient and mobility of a given semiconductor material using Hall-effect set up. **8.** To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's experiment. **9.** To compare Illuminating Powers by a Photometer. **10.** To determine the frequency of A.C. mains by means of a Sonometer. **11.** To determine refractive index of a prism material by spectrometer. **12.** To determine the Flashing & Quenching of Neon bulb. **13.** Determination of Cauchy's constant by using spectrometer. **14.** To study the PN junction characteristics. **15.** To determine the resolving power and dispersive power by a prism. **16.** To determine the value of Boltzmann Constant by studying Forward Characteristics of a Diode. **17.** Study the characteristics of LDR. **18.** To study the characteristics of a photo-cell.	
Text Books:	1. B.Sc.Practical Physics, Gupta and Kumar, Pragati Prakashan.	
Reference Books:	1. B.Sc.Practical Physics, Gupta and Kumar, Pragati Prakashan. 2. B.Sc. Practical Physics, C.L. Arora, S. Chand & Company Pvt. Ltd. 3. B.Sc. Practical Physics, C.L. Arora, S. Chand & Company Pvt. Ltd. *** Latest editions of all the suggested books are recommended.**	

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)

Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: **EAS163**	**Specialization- Data Science** **B.Tech.- Semester-I** **Engineering Chemistry (Lab)**	**L-0** **T-0** **P-2** **C-1**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** the concepts of Hardness of water.	
CO2.	**Analyzing** & estimating of various parameters of water.	
CO3.	**Analyzing** of Calorific value of Solid fuel by Bomb calorimeter & Liquid Fuels by Junkers Gas Calorimeter.	
CO4.	**Analyzing** of open & closed Flash point of oil by Cleveland & Pensky's Martens apparatus.	
CO5.	**Analyzing** of viscosity of lubricating oil using Redwood Viscometer.	
Course Content:	**Select any ten experiments from the following list.**	
LIST OF EXPERIMENTS	**1.** Determination of Total Hardness of a given water sample. **2.** Determination of mixed alkalinity (a) Hydroxyl & Carbonate (b) Carbonate & Bicarbonate **3.** To determine the pH of the given solution using pH meter and pH-metric titration. **4.** Determination of dissolved oxygen content of given water sample. **5.** To find chemical oxygen demand of waste water sample by potassium dichromate **6.** Determination of free chlorine in a given water sample. **7.** To determine the chloride content in the given water sample by Mohr's method. **8.** To prepare the Bakelite resin polymer. **9.** To determine the concentration of unknown sample of iron spectrophotometrically. **10.** To determine the viscosity of a given sample of a lubricating oil using Redwood Viscometer. **11.** To determine the flash & fire point of a given lubricating oil. **12.** Determination of calorific value of a solid or liquid fuel. **13.** Determination of calorific value of a gaseous fuel. **14.** Determination of % of O_2, CO_2, % CO in flue gas sample using Orsat apparatus. **15.** Proximate analysis of coal sample.	
Reference Books:	1. Agarwal R. K., Engineering Chemistry, Krishna Prakashan. *** Latest editions of all the suggested books are recommended.**	

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)

Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: **EEE161**	**Specialization- Data Science** **B.Tech.- Semester-I** **Basic Electrical Engineering (Lab)**	**L-0** **T-0** **P-2** **C-1**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** the concepts of Kirchoff & Voltage law.	
CO2.	**Understanding** the concepts of Thevenin & Norton theorem.	
CO3.	**Analyzing** the energy by a single-phase energy meter.	
CO4.	**Analyzing** the losses and efficiency of Transformer on different load conditions.	
CO5.	**Analyzing** the electrical circuits using electrical and electronics components on bread board.	
Course Content:	**Select any ten experiments from the following list.**	
List of Experiments	**1.** To verify the Kirchhoff's current and voltage laws. **2.** To study multimeter. **3.** To verify the Superposition theorem. **4.** To verify the Thevenin's theorem. **5.** To verify the Norton's theorem. **6.** To verify the maximum power transfer theorem. **7.** To verify current division and voltage division rule. **8.** To measure energy by a single-phase energy meter. **9.** To measure the power factor in an RLC by varying the capacitance **10.** To determine resonance frequency, quality factor, bandwidth in series resonance. **11.** To measure the power in a 3-phase system by two-wattmeter method **12.** To measure speed for speed control of D.C. Shunt Motor. **13.** To determine the efficiency of single-phase transformer by load test.	
Reference Books:	1. Fitzgerald A.E & Higginbotham., D.E., Basic Electrical Engineering, McGraw Hill. *** Latest editions of all the suggested books are recommended.**	

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)

Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: **EEC161**	**Specialization- Data Science** **B.Tech.- Semester-I** **Basic Electronics Engineering(Lab)**	**L-0** **T-0** **P-2** **C-1**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** the implementation of diode-based circuits.	
CO2.	**Understanding** the implementation of Operational amplifier-based circuits.	
CO3.	**Analyzing** the characteristics of pn junction diode & BJT.	
CO4.	**Analyzing** the different parameters for characterizing different circuits like rectifiers, regulators using diodes and BJTs.	
CO5.	**Analyzing** the truth tables through the different type's adders.	
Course Content:	**Minimum eight experiments should be performed-**	
List of Experiments	**1.** To study the V-I characteristics of p-n junction diode. **2.** To study the diode as clipper and clamper. **3.** To study the half-wave rectifier using silicon diode. **4.** To study the full-wave rectifier using silicon diode. **5.** To study the Zener diode as a shunt regulator. **6.** To study transistor in Common Base configuration & plot its input/output characteristics. **7.** To study the operational amplifier in inverting & non-inverting modes using IC 741. **8.** To study the operational amplifier as differentiator & integrator. **9.** To study various logic gates & verify their truth tables. **10.** To study half adder/full adder & verify their truth tables.	
Reference Books:	1. Sedra and Smith, Microelectronic Circuits, Oxford University Press. 2. Chattopadhyay D and P C Rakshit, Electronics Fundamentals and Applications, New Age International. *** Latest editions of all the suggested books are recommended.**	

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)
Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)
The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: **EME161**	**Specialization- Data Science** **B.Tech.- Semester-I** **Engineering Drawing (Lab)**	**L-0** **T-0** **P-4** **C-2**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** the concepts of Engineering Drawing.	
CO2.	**Understanding** how to draw and represent the shape, size & specifications of physical objects.	
CO3.	**Applying** the principles of projection and sectioning.	
CO4.	**Applying** the concepts of development of the lateral surface of a given object.	
CO5.	**Creating** isometric projection of the given orthographic projection.	
Course Content:	**All to be performed**	
List of Experiments	1. To write all Numbers (0 to 9) and alphabetical Letters (A to Z) as per the standard dimensions. 2. To draw the types of lines and conventions of different materials. 3. To draw and study dimensioning and Tolerance. 4. To construction geometrical figures of Pentagon and Hexagon 5. To draw the projection of points and lines 6. To draw the Orthographic Projection of given object in First Angle 7. To draw the Orthographic Projection of given object in Third Angle 8. To draw the sectional view of a given object 9. To draw the development of the lateral surface of given object **10.** To draw the isometric projection of the given orthographic projection	

Evaluation Scheme of Practical Examination:
Internal Evaluation (50 marks)
Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the drawing sheet by the students and a Viva taken by the faculty concerned. The marks shall be given on the drawing sheet & regard maintained by the faculty.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)
The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

Drawing Sheet (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: **EME162**	**Specialization- Data Science** **B.Tech.- Semester-I** **Workshop Practice (Lab)**	**L-0** **T-0** **P-4** **C-2**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** the concepts to prepare simple wooden joints using wood working tools.	
CO2.	**Applying** the techniques to produce fitting jobs of specified dimensions.	
CO3.	**Applying** the concepts to prepare simple lap, butt, T and corner joints using arc welding equipment.	
CO4.	**Applying** the concepts of black smithy and lathe machine to produce different jobs.	
CO5.	**Creating** core and moulds for casting.	
Course Content:	**Perform any ten experiments selecting at least one from each shop**	
List of Experiments	**Carpentry Shop**: 1. To prepare half-lap corner joint. 2. To prepare mortise & tenon joint. 3. To prepare a cylindrical pattern on woodworking lathe. **Fitting Bench Working Shop:** 1. To prepare a V-joint fitting 2. To prepare a U-joint fitting 3. To prepare a internal thread in a plate with the help of tapping process **Black Smithy Shop:** 1. To prepare a square rod from given circular rod 2. To prepare a square U- shape from given circular rod **Welding Shop:** 1. To prepare a butt and Lap welded joints using arc welding machine. 2. To prepare a Lap welded joint Gas welding equipment. 3. To prepare a Lap welded joint using spot welding machine. **Sheet-metal Shop:** 1. To make round duct of GI sheet using 'soldering' process. 2. To prepare a tray of GI by fabrication **Machine Shop:** 1. To study the working of basic machine tools like Lathe m/c, Shaper m/c, Drilling m/c and Grinding m/c. 2. To perform the following operations on Centre Lathe: Turning, Step turning, Taper turning, Facing, Grooving and Knurling 3. To perform the operations of drilling of making the holes on the given metallic work-piece (M.S.) by use of drilling machine. **Foundry Shop:** 1. To prepare core as per given size. 2. To prepare a mould for given casting.	

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)

Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: **EAS211**	**Specialization- Data Science** **B.Tech.- Semester-II** **Engineering Mathematics-II**	**L-3** **T-1** **P-0** **C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** the concepts of the wave, diffusion and Laplace equations & Fourier series.	
CO2.	**Understanding** the methods of separation of variables	
CO3.	**Understanding** the concepts of Fourier series' representation of single variable function.	
CO4.	**Applying** Laplace transform to determine the complete solutions of linear ODE	
CO5.	**Applying** the method of variations of parameters to find solution of equations with variable coefficients.	
Course Content:		
Unit-1:	**Differential Equations:** Linear Differential Equation, Linear Differential Equation with constant coefficient: Complementary functions and particular integrals, Linear Differential Equation with variable coefficient: Removal method, changing independent variables, Method of variation of parameters, Homogeneous Linear Differential Equation, Simultaneous linear differential equations.	**8 Hours**
Unit-2:	**Series Solutions:** PowerSeries solutions of ODE, Ordinary Point, Singular Points, Frobenius Method. **Special Functions:** Legendre equation and Polynomial, Legendre Function, Rodrigue's formula, Laplace definite integral for first and second kind, Bessel equation and Polynomial, Bessel Function, Orthogonal properties and Recurrence Relation for Legendre and Bessel function.	**8 Hours**
Unit-3:	**Partial differential equations –**Method of separation of variables for solving partial differential equations; Wave equation up to two dimensions; Laplace equation in two-dimensions; Heat conduction equations up to two-dimensions; Equations of transmission Lines.	**8 Hours**
Unit-4:	**Fourier Series:** Periodic functions, Trigonometric series; Fourier series; Dirichlet's conditions, Determination of fourier coefficient by Euler's formulae; Fourier series for discontinuous functions, Even and odd functions, Half range sine and cosine series.	**8 Hours**
Unit-5:	**Laplace Transform:** Laplace transform; Existence theorem; Laplace transform of derivatives and integrals; Inverse Laplace transform; Unit step function; Diratch delta function; Laplace transform of periodic functions; Convolution theorem.	**8 Hours**
Text Books:	1. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers.	
Reference Books:	1. Kreyszig E., Advanced Engineering Mathematics, Wiley Eastern. 2. Narayan Shanti, A Text book of Matrices, S. Chand 3. Prasad C., Engineering Mathematics for Engineers, Prasad Mudralaya. 4. Das H.K., Engineering Mathematics Vol-II, S. Chand. *** Latest editions of all the suggested books are recommended.**	
Additional	1. https://www.youtube.com/watch?v=luJMl37-nso	

electronic reference material:	**2.** https://www.youtube.com/watch?v=NdouX5-KD6Y	

Course Code: EAS212	**Specialization- Data Science** **B.Tech.- Semester-II** **Engineering Physics**	**L-3 T-1 P-0 C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** the basic concepts of interference, diffraction and polarisation.	
CO2.	**Understanding** the concept of bonding in solids and semiconductors.	
CO3.	**Understanding** the special theory of relativity.	
CO4.	**Applying** special theory of relativity to explain the phenomenon of length contraction, time dilation, mass-energy equivalence etc.	
CO5.	**Applying** the concepts of polarized light by the Brewster's and Malus Law	
Course Content:	**Unit A(Unit A is for building a foundation and shall not be a part of examination)** Optics- Properties of light, Lance, Mirror, Focal length, Intensity, Power, Eye-piece, Work, Energy and its types, Waves, longitudinal and transverse waves, Time period, Frequency	
Unit-1:	**Interference of Light:** Introduction,Principle of Superposition, Interference due to division of wavefront: Young's double slit experiment, Theory of Fresnel's Bi-Prism, Interference due to division of amplitude: parallel thin films, Wedge shaped film, Michelson's interferometer, Newton's ring.	**8 Hours**
Unit-2:	**Diffraction**: Introduction, Types of Diffraction and difference between them, Condition for diffraction, difference between interference and diffraction. **Single slit diffraction**: Quantitative description of maxima and minima with intensity variation, linear and angular width of central maxima. **Resolving Power**: Rayleigh's criterion of resolution, resolving power of diffraction grating and telescope.	**8 Hours**
Unit-3:	**Polarization:** Introduction, production of plane polarized light by different methods, Brewster's and Malus Law. Quantitative description of double refraction, Nicol prism, Quarter & half wave plate, specific rotation, Laurent's half shade polarimeter.	**8 Hours**
Unit-4:	**Elements of Material Science:** Introduction, Bonding in solids, Covalent bonding and Metallic bonding, Classification of Solids as Insulators, Semi-Conductor and Conductors, Intrinsic and Extrinsic Semiconductors, Conductivity in Semiconductors, Determination of Energy gap of Semiconductor. **Hall Effect:** Theory, Hall Coefficients and application to determine the sign of charge carrier, Concentration of charge carrier, mobility of charge carriers.	**8 Hours**
Unit-5:	**Special Theory of Relativity:** Introduction, Inertial and non-inertial frames of Reference, Postulates of special theory of relativity, Galilean and Lorentz Transformations, Length contraction and Time Dilation, Relativistic addition of velocities, Variation of mass with velocity, Mass-Energy equivalence.	**8 Hours**
Text Books:	1. Elements of Properties of Matter, D. S. Mathur, S. Chand & Co.	
Reference Books:	1. F. A. Jenkins and H. E. White, Fundamentals of Optics, McGraw-Hill. 2. Concept of Modern Physics, Beiser, Tata McGraw-Hill. 3. Engineering Physics, Bhattacharya & Tandon, Oxford University Press. 4. H. K. Malik & A.K. Singh, Engineering Physics, McGraw-Hill, latest edition. *** Latest editions of all the suggested books are recommended.**	

Additional electronic reference material:	1. https://www.youtube.com/watch?v=toGH5BdgRZ4&list=PLD9DDFBDC338226CA 2. https://www.youtube.com/watch?v=CuqsU7B1MtU	

Course Code: **EAS213**	**Specialization- Data Science** **B.Tech.- Semester-II** **Engineering Chemistry**	**L-3 T-1 P-0 C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** the concept of softening & purification of water.	
CO2.	**Understanding** calorific value& combustion, analysis of coal, Physical & Chemical properties of hydrocarbons & quality improvements.	
CO3.	**Understanding** the concept of lubrication, Properties of Refractory & Manufacturing of cements.	
CO4.	**Applying** the concepts of the mechanism of polymerization reactions, Natural and synthetic rubber& vulcanization.	
CO5.	**Applying** the concepts of spectroscopic & chromatographic techniques.	
Course Content:		
Unit-1:	**Water and Its Industrial Applications:** Sources, Impurities, Hardness and its units, Industrial water, characteristics, softening of water by various methods (External and Internal treatment), Boiler trouble causes effects and remedies, Characteristic of municipal water and its treatment, Numerical problem based on water softening method like lime soda, calgon etc.	**8 Hours**
Unit-2:	**Fuels and Combustion:** Fossil fuel and classification, calorific value, determination of calorific value by Bomb and Jumker's calorimeter, proximate and ultimate analysis of coal and their significance, calorific value computation based on ultimate analysis data, Combustion and its related numerical problems carbonization manufacturing of coke, and recovery of byproduct, knocking relationship between knocking and structure and hydrocarbon, improvement ant knocking characteristic IC Engine fuels, Diesel Engine fuels, Cetane Number.	**8 Hours**
Unit-3:	**Lubricants:** Introduction, mechanism of lubrication, classification of lubricant, properties and testing of lubricating Oil Numerical problem based on testing methods. Cement and Refractories: Manufacture, IS code, Setting and hardening of cement, Portland cement Plaster of Paris, Refractories. Introduction, classification and properties of refractories.	**8 Hours**
Unit-4:	**Polymers:** Introduction, types and classification of polymerization, reaction mechanism, Natural and synthetic rubber, Vulcanization of rubber, preparation, properties and uses of the following Polythene, PVC, PMMA, Teflon, Polyacrylonitrile, PVA, Nylon 6, Terylene, Phenol Formaldehyde, Urea Formaldehyde Resin, Glyptal, Silicones Resin, Polyurethanes, Butyl Rubber, Neoprene, Buna N, Buna S.	**8 Hours**
Unit-5:	**A. Instrumental Techniques in chemical analysis:** Introduction, Principle, Instrumentation and application of IR, NMR, UV, Visible, Gas Chromatography, Lambert and Beer's Law. **B. Water Analysis Techniques:** Alkalinity, Hardness (Complexometric), Chlorides, Free Chlorine, DO, BOD, and COD, Numerical Problem Based on above techniques.	**8 Hours**
Text Books:	1. Agarwal R. K., Engineering Chemistry, Krishna Prakashan.	

Reference Books:	1. Morrison & Boyd, Organic Chemistry, Prentice Hall 2. Barrow Gordon M., Physical Chemistry, McGraw-Hill. 3. Manahan Stanley E., Environmental Chemistry, CRC Press. 4. Lee I.D., Inorganic Chemistry. 5. Chawla Shashi, Engineering Chemistry, Dhanpat Rai Publication. *** Latest editions of all the suggested books are recommended.**	
Additional electronic reference material:	1. https://www.youtube.com/watch?v=RV-OyRTaIOI 2. https://www.youtube.com/watch?v=phhfkikb6Lw	

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Course Code: **EEE217**	**Specialization- Data Science** **B.Tech.- Semester-II** **Basic Electrical Engineering**	**L-3** **T-1** **P-0** **C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** the basics of Network, AC Waveform and its characteristics.	
CO2.	**Understanding** the basic concept of Measuring Instruments, Transformers & three phase Power systems.	
CO3.	**Understanding** the basic concepts of Transformer.	
CO4.	**Understanding** the basic concept of power measurement using two wattmeter methods.	
CO5.	**Applying** the concept of Kirchhoff's laws and Network Theorems to analyze complex electrical circuits.	
Course Content:		
Unit-1:	**D.C. Network Theory:** Passive, active, bilateral, unilateral, linear, nonlinear element, Circuit theory concepts-Mesh and node analysis; Voltage and current division, source transformation, Network Theorems-Superposition theorem, Thevenin's theorem, Norton's theorem, and Maximum Power Transfer theorem, Star-delta & delta-star conversion.	**8 Hours**
Unit-2:	**Steady State Analysis of A.C. Circuits:** Sinusoidal and phasor representation of voltage and Current; Single phase A.C. circuit behavior of resistance, inductance and capacitance and their Combination in series & parallel; Power factor; Series and parallel resonance; Band width and Quality factor.	**8 Hours**
Unit-3:	**Basics of Measuring Instruments:** Introduction to wattmeter & Energy meter extension range of voltmeter and ammeter. **Three Phase A.C. Circuits:** Line and phase voltage/current relations; three phase power, power measurement using two wattmeter methods.	**8 Hours**
Unit-4:	**Single phase Transformer:** Principle of operation; Types of construction; Phasor diagram; Equivalent circuit; Efficiency and losses.	**8 Hours**
Unit-5:	**Electrical machines:** DC machines: Principle & Construction, Types, EMF equation of generator and torque equation of motor, applications of DC motors (simple numerical problems)	**8 Hours**
Text Books:	1. V. Del Toro, Principles of Electrical Engineering, Prentice-Hall International.	
Reference Books:	1. Fitzgerald A.E & Higginbotham., D.E., Basic Electrical Engineering, McGraw Hill. 2. A Grabel, Basic Electrical Engineering, McGraw Hill. 3. Cotton H., Advanced Electrical Technology, Wheeler Publishing. 4. W.H. Hayt & J.E. Kemmerly, Engineering Circuit Analysis, McGraw Hill. 5. Nagrath I.J., Basic Electrical Engineering, Tata McGraw Hill. *** Latest editions of all the suggested books are recommended.**	
Additional electronic reference material:	1. https://nptel.ac.in/courses/108/108/108108076/ 2. https://sites.google.com/tmu.ac.in/dr-garima-goswami/home	

Course Code: **EEC211**	**Specialization- Data Science** **B.Tech.- Semester-II** **Basic Electronics Engineering**	**L-3** **T-1** **P-0** **C-4**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** the concepts of electronic components like diode, BJT & FET.	
CO2.	**Understanding** the applications of pn junction diode as clipper, clamper, rectifier & regulator whereas BJT & FET as amplifiers	
CO3.	**Understanding** the functions and applications of operational amplifier-based circuits such as differentiator, integrator, and inverting, non-inverting, summing & differential amplifier.	
CO4.	**Understanding** the concepts of number system, Boolean algebra and logic gates.	
CO5.	**Applying** the knowledge of series, parallel and electromagnetic circuits.	
Course Content:		
Unit-1:	**p-n Junction:** Energy band diagram in materials, Intrinsic & Extrinsic Semiconductor, Introduction to PN-Junction, Depletion layer, V-I characteristics, p-n junction as rectifiers (half wave and full wave), calculation of ripple factor of rectifiers, clipping and clamping circuits, Zener diode and its application as shunt regulator.	**8 Hours**
Unit-2:	**Bipolar Junction Transistor (BJT):** Basic construction, transistor action; CB, CE and CCconfigurations, input/output characteristics, Relation between α, β & γ, Biasing of transistors: Fixed bias, emitter bias, potential divider bias.	**8 Hours**
Unit-3:	**Field Effect Transistor (FET):** Basic construction of JFET; Principle of working; concept of pinch-off condition & maximum drain saturation current; input and transfer characteristics; Characteristics equation; fixed and self-biasing of JFET amplifier; Introduction of MOSFET; Depletion and Enhancement type MOSFET- Construction, Operation and Characteristics.	**8 Hours**
Unit-4:	**Operational Amplifier (Op-Amp):** Concept of ideal operational amplifier; ideal and practical Op-Amp parameters; inverting, non-inverting and unity gain configurations, Applications of Op-Amp as adders, difference amplifiers, integrators and differentiator.	**8 Hours**
Unit-5:	**Switching Theory:** Number system, conversion of bases (decimal, binary, octal and hexadecimalnumbers), Addition & Subtraction, BCD numbers, Boolean algebra, De Morgan's Theorems, Logic gates and truth table-AND, OR & NOT,Seven segment display & K map.	**8 Hours**
Text Books:	1. Robert Boylestad & Louis Nashelsky, Electronic Circuit and Devices, Pearson India.	
Reference Books:	1. Sedra and Smith, Microelectronic Circuits, Oxford University Press. 2. Gayakwad, R A, Operational Amplifiers and Linear Integrated circuits, Prentice Hall of India Pvt. Ltd. 3. Chattopadhyay D and P C Rakshit, Electronics Fundamentals and Applications, New Age International. *** Latest editions of all the suggested books are recommended.**	

Additional electronic reference material:	1. https://www.youtube.com/watch?v=USrY0JspDEg 2. https://www.youtube.com/watch?v=Hkz27cFW4Xs	

Course Code: **IDS201**	**Specialization- Data Science** **B.Tech.- Semester-II** **Programming in C**	**L-3** **T-0** **P-0** **C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the Concepts of problem solving.	
CO2.	Understanding the use of basic concepts involved in Computer Programming.	
CO3.	Understanding the concepts of design, implement, test, debug and document programs in C.	
CO4.	Understanding the concepts of various function in C and its application.	
CO5.	Applying various programming concepts to design an application.	
Course Content:		
Unit-1:	**Basics of programming: Approaches** to Problem Solving, Concept of algorithm and flow charts, **Types of computer languages**:- Machine Language, Assembly Language and High Level Language, Concept of Assembler, Compiler, Loader and Linker	**8 Hours**
Unit-2:	**Fundamental data types**- Character type, integer, short, long, unsigned, single and double floating point, Storage classes- automatic, register, static and external, Operators and expression using numeric and relational operators, mixed operands, type conversion, logical operators, bit operations, assignment operator, operator precedence and associativity. **Fundamentals of C programming**: Structure of C program, writing and executing the first C program, components of C language. Standard I/O in C.	**8 Hours**
Unit-3:	**Conditional program execution:** Applying if and switch statements, nesting if and else, use of break and default with switch, program loops and iterations: use of while, do while and for loops, multiple loop variables, use of break and continue statements. **Pointers:** Introduction, declaration, applications	**8 Hours**
Unit-4:	**Arrays:** Array notation and representation, manipulating array elements, using multidimensional arrays. Structure, union, enumerated data types, **Functions:** Introduction, types of functions, functions with array, passing values to functions, recursive functions.	**8 Hours**
Unit-5:	**File Handling :** File handling, standard C preprocessors, defining and calling macros, conditional compilation, passing values to the compiler. **C Preprocessor-** #define, #include, #undef, Conditional compilation directives. **C standard library and header files**: Header files, string functions, mathematical functions, Date and Time functions	**8 Hours**
Text Books:	1. Programming in ANSI C by Balaguruswamy, 3rd Edition, 2005, Tata McGraw Hill.	
Reference Books:	1. Let us C by Yashwant Kanetka, 6th Edition, PBP Publication. 2. The C programming Language by Richie and Kenninghan, 2004, BPB Publication. *** Latest editions of all the suggested books are recommended.**	
E-Content Reference	1. https://www.tutorialspoint.com/cprogramming/index.htm 2. http://cslibrary.stanford.edu/101/EssentialC.pdf	

Course Code: **TMUGE201**	**Specialization- Data Science** **B.Tech.- Semester-II** **English Communication -II**	**L-2** **T-0** **P-2** **C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Remembering & understanding the basics of English Grammar and Vocabulary.	
CO2.	Understanding the basics of Listening, Speaking & Writing Skills.	
CO3.	Applying correct vocabulary and tenses in sentence construction while writing and delivering presentations.	
CO4.	Analyzing different types of listening, role of Audience & Locale in presentation.	
CO5.	Drafting Official Letters, E-Mail & Paragraphs in correct format.	
Course Content:		
Unit-1:	**Functional Grammar** • Prefix, suffix and One words substitution • Modals • Concord	**10 Hours**
Unit-2:	**Listening Skills** • Difference between listening & hearing, Process and Types of Listening • Importance and Barriers to listening	**4 Hours**
Unit-3:	**Writing Skills** • Official letter and email writing • Essentials of a paragraph, • Developing a paragraph: Structure and methods • Paragraph writing (100-120 words)	**12 Hours**
Unit-4:	**Strategies & Structure of Oral Presentation** • Purpose, Organizing content, Audience & Locale, Audio-visual aids, Body langauge • Voice dynamics: Five P's - Pace, Power, Pronunciation, Pause, and Pitch. • Modes of speech delivery and 5 W's of presentation	**8 Hours**
Unit-5:	**Value based text reading:** Short Essay (Non- detailed study) • How should one Read a book? – Virginia Woolf	**6 Hours**
Text Books:	1. Singh R.P., An Anthology of English Essay, O.U.P. New Delhi.	
Reference Books:	1. Nesfield J.C. "*English Grammar Composition & Usage*" Macmillan Publishers 2. Sood Madan "*The Business letters"* Goodwill Publishing House, New Delhi 3. Kumar Sanjay &Pushplata "*Communication Skills*" Oxford University Press, New Delhi. *** Latest editions of all the suggested books are recommended.**	
Additional Electronic	**1.** https://www.youtube.com/watch?v=A0uekze2GOU **2.** https://www.youtube.com/watch?v=JIKU_WT0Bls	

Reference Material	**3.** https://www.youtube.com/watch?v=3Tu1jN65slw **4.** https://youtu.be/sb6ZZ2p3hEM **5.** https://youtu.be/yY6-cgShhac **6.** https://youtu.be/cc4yXwOQsBk	

Methodologies:

1. Words and exercises, usage in sentences.
2. Language Lab software.
3. Sentence construction on daily activities and conversations.
4. Format and layout to be taught with the help of samples and preparing letters on different subjects.
5. JAM sessions and Picture presentation.
6. Tongue twisters, Newspaper reading and short movies.
7. Modern Teaching tools (PPT Presentation, Tongue-Twisters & Motivational videos with sub-titles) will be utilized.
8. Text reading : discussion in detail, critical appreciation by reading the text to develop students' reading habits with voice modulation.

Note:

- Class (above 30 students) will be divided in to two groups for effective teaching.
- For effective conversation practice, groups will be changed weekly.

Evaluation Scheme

Internal Evaluation			**External Evaluation**		**Total Marks**
40 Marks			**60 Marks**		**100**
20 Marks (Best 2 out of Three CTs) ***(From Unit- I, IV & V)***	10 Marks (Oral Assignments) ***(From Unit- II &IV)***	10 Marks (Attendance)	40 Marks (External Written Examination) ***(From Unit- I, IV & V)***	20 Marks (External Viva)* ***(From Unit- II &IV)***	

*Parameters of External Viva

Content	**Body Language**	**Communication skills**	**Confidence**	**TOTAL**
05 Marks	05 Marks	05 Marks	05 Marks	20 Marks

Note: External Viva will be conducted by 2-member committee comprising

a) One Faculty teaching the class

b) One examiner nominated by University Examination cell.

Each member will evaluate on a scale of 20 marks and the average of two would be the 20 marks obtained by the students.

Course Code: **EAS262**	**Specialization- Data Science** **B.Tech.- Semester-II** **Engineering Physics (Lab)**	**L-0** **T-0** **P-2** **C-1**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** of the operation of various models of optical devices.	
CO2.	**Understanding** types of Semiconductors using Hall experiments.	
CO3.	**Applying** the concept of interference, polarization & dispersion in optical devices through Newton's ring, Laser, polarimeter & spectrometer.	
CO4.	**Applying** the concept of resonance to determine the AC frequency using sonometer & Melde's apparatus.	
CO5.	**Applying** the concept of resolving & dispersive power by a prism.	
Course Content:	**Note: Select any ten experiments from the following list.**	
LIST OF EXPERIMENTS	**1.** To determine the wavelength of monochromatic light by Newton's ring. **2.** To determine the wavelength of monochromatic light by Michelson-Morley experiment. **3.** To determine the wavelength of monochromatic light by Fresnel's Bi-prism. **4.** To determine the Planck's constant using LEDs of different colours. **5.** To determine the specific rotation of cane sugar solution using Polarimeter. **6.** To verify Stefan's Law by electrical method. **7.** To study the Hall Effect and determine Hall coefficient and mobility of a given semiconductor material using Hall-effect set up. **8.** To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's experiment. **9.** To compare Illuminating Powers by a Photometer. **10.** To determine the frequency of A.C. mains by means of a Sonometer. **11.** To determine refractive index of a prism material by spectrometer. **12.** To determine the Flashing & Quenching of Neon bulb. **13.** Determination of Cauchy's constant by using spectrometer. **14.** To study the PN junction characteristics. **15.** To determine the resolving power and dispersive power by a prism. **16.** To determine the value of Boltzmann Constant by studying Forward Characteristics of a Diode. **17.** Study the characteristics of LDR. **18.** To study the characteristics of a photo-cell.	
Text Books:	1. B.Sc.Practical Physics, Gupta and Kumar, Pragati Prakashan.	
Reference Books:	1. B.Sc.Practical Physics, Gupta and Kumar, Pragati Prakashan. 2. B.Sc. Practical Physics, C.L. Arora, S. Chand & Company Pvt. Ltd. 3. B.Sc. Practical Physics, C.L. Arora, S. Chand & Company Pvt. Ltd. *** Latest editions of all the suggested books are recommended.**	

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)

Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: **EAS263**	**Specialization- Data Science** **B.Tech.- Semester-II** **Engineering Chemistry (Lab)**	**L-0** **T-0** **P-2** **C-1**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** the concepts of Hardness of water.	
CO2.	**Analyzing** & estimating of various parameters of water.	
CO3.	**Analyzing** of Calorific value of Solid fuel by Bomb calorimeter & Liquid Fuels by Junkers Gas Calorimeter.	
CO4.	**Analyzing** of open & closed Flash point of oil by Cleveland & Pensky's Martens apparatus.	
CO5.	**Analyzing** of viscosity of lubricating oil using Redwood Viscometer.	
Course Content:	**Select any ten experiments from the following list.**	
LIST OF EXPERIMENTS	**1.** Determination of Total Hardness of a given water sample. **2.** Determination of mixed alkalinity (a) Hydroxyl & Carbonate (b) Carbonate & Bicarbonate **3.** To determine the pH of the given solution using pH meter and pH-metric titration. **4.** Determination of dissolved oxygen content of given water sample. **5.** To find chemical oxygen demand of waste water sample by potassium dichromate **6.** Determination of free chlorine in a given water sample. **7.** To determine the chloride content in the given water sample by Mohr's method. **8.** To prepare the Bakelite resin polymer. **9.** To determine the concentration of unknown sample of iron spectrophotometrically. **10.** To determine the viscosity of a given sample of a lubricating oil using Redwood Viscometer. **11.** To determine the flash & fire point of a given lubricating oil. **12.** Determination of calorific value of a solid or liquid fuel. **13.** Determination of calorific value of a gaseous fuel. **14.** Determination of % of O_2, CO_2, % CO in flue gas sample using Orsat apparatus. **15.** Proximate analysis of coal sample.	
Reference Books:	1. Agarwal R. K., Engineering Chemistry, Krishna Prakashan. *** Latest editions of all the suggested books are recommended.**	

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)

Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: **EEE261**	**Specialization- Data Science** **B.Tech.- Semester-II** **Basic Electrical Engineering (Lab)**	**L-0** **T-0** **P-2** **C-1**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** the concepts of Kirchoff & Voltage law.	
CO2.	**Understanding** the concepts of Thevenin & Norton theorem.	
CO3.	**Analyzing** the energy by a single-phase energy meter.	
CO4.	**Analyzing** the losses and efficiency of Transformer on different load conditions.	
CO5.	**Analyzing** the electrical circuits using electrical and electronics components on bread board.	
Course Content:	**Select any ten experiments from the following list.**	
List of Experiments	**1.** To verify the Kirchhoff's current and voltage laws. **2.** To study multimeter. **3.** To verify the Superposition theorem. **4.** To verify the Thevenin's theorem. **5.** To verify the Norton's theorem. **6.** To verify the maximum power transfer theorem. **7.** To verify current division and voltage division rule. **8.** To measure energy by a single-phase energy meter. **9.** To measure the power factor in an RLC by varying the capacitance **10.** To determine resonance frequency, quality factor, bandwidth in series resonance. **11.** To measure the power in a 3-phase system by two-wattmeter method **12.** To measure speed for speed control of D.C. Shunt Motor. **13.** To determine the efficiency of single-phase transformer by load test.	
Reference Books:	1. Fitzgerald A.E & Higginbotham., D.E., Basic Electrical Engineering, McGraw Hill. *** Latest editions of all the suggested books are recommended.**	

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)

Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: **EEC261**	**Specialization- Data Science** **B.Tech.- Semester-II** **Basic Electronics Engineering(Lab)**	**L-0** **T-0** **P-2** **C-1**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** the implementation of diode-based circuits.	
CO2.	**Understanding** the implementation of Operational amplifier-based circuits.	
CO3.	**Analyzing** the characteristics of pn junction diode & BJT.	
CO4.	**Analyzing** the different parameters for characterizing different circuits like rectifiers, regulators using diodes and BJTs.	
CO5.	**Analyzing** the truth tables through the different type's adders.	
Course Content:	**Minimum eight experiments should be performed-**	
List of Experiments	**1.** To study the V-I characteristics of p-n junction diode. **2.** To study the diode as clipper and clamper. **3.** To study the half-wave rectifier using silicon diode. **4.** To study the full-wave rectifier using silicon diode. **5.** To study the Zener diode as a shunt regulator. **6.** To study transistor in Common Base configuration & plot its input/output characteristics. **7.** To study the operational amplifier in inverting & non-inverting modes using IC 741. **8.** To study the operational amplifier as differentiator & integrator. **9.** To study various logic gates & verify their truth tables. **10.** To study half adder/full adder & verify their truth tables.	
Reference Books:	1. Sedra and Smith, Microelectronic Circuits, Oxford University Press. 2. Chattopadhyay D and P C Rakshit, Electronics Fundamentals and Applications, New Age International. *** Latest editions of all the suggested books are recommended.**	

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)
Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)
The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: **EME261**	**Specialization- Data Science** **B.Tech.- Semester-II** **Engineering Drawing (Lab)**	**L-0 T-0 P-4 C-2**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** the concepts of Engineering Drawing.	
CO2.	**Understanding** how to draw and represent the shape, size & specifications of physical objects.	
CO3.	**Applying** the principles of projection and sectioning.	
CO4.	**Applying** the concepts of development of the lateral surface of a given object.	
CO5.	**Creating** isometric projection of the given orthographic projection.	
Course Content:	**All to be performed**	
List of Experiments	1. To write all Numbers (0 to 9) and alphabetical Letters (A to Z) as per the standard dimensions. 2. To draw the types of lines and conventions of different materials. 3. To draw and study dimensioning and Tolerance. 4. To construction geometrical figures of Pentagon and Hexagon 5. To draw the projection of points and lines 6. To draw the Orthographic Projection of given object in First Angle 7. To draw the Orthographic Projection of given object in Third Angle 8. To draw the sectional view of a given object 9. To draw the development of the lateral surface of given object **10.** To draw the isometric projection of the given orthographic projection	

Evaluation Scheme of Practical Examination:
Internal Evaluation (50 marks)
Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the drawing sheet by the students and a Viva taken by the faculty concerned. The marks shall be given on the drawing sheet & regard maintained by the faculty.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)
The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

Drawing Sheet (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Note: The drawing sheet could be manual or in Auto CAD.

Course Code: **EME262**	**Specialization- Data Science** **B.Tech.- Semester-II** **Workshop Practice (Lab)**	**L-0** **T-0** **P-4** **C-2**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	**Understanding** the concepts to prepare simple wooden joints using wood working tools.	
CO2.	**Applying** the techniques to produce fitting jobs of specified dimensions.	
CO3.	**Applying** the concepts to prepare simple lap, butt, T and corner joints using arc welding equipment.	
CO4.	**Applying** the concepts of black smithy and lathe machine to produce different jobs.	
CO5.	**Creating** core and moulds for casting.	
Course Content:	**Perform any ten experiments selecting at least one from each shop**	
List of Experiments	**Carpentry Shop**: 1. To prepare half-lap corner joint. 2. To prepare mortise & tenon joint. 3. To prepare a cylindrical pattern on woodworking lathe. **Fitting Bench Working Shop:** 1. To prepare a V-joint fitting 2. To prepare a U-joint fitting 3. To prepare a internal thread in a plate with the help of tapping process **Black Smithy Shop:** 1. To prepare a square rod from given circular rod 2. To prepare a square U- shape from given circular rod **Welding Shop:** 1. To prepare a butt and Lap welded joints using arc welding machine. 2. To prepare a Lap welded joint Gas welding equipment. 3. To prepare a Lap welded joint using spot welding machine. **Sheet-metal Shop:** 1. To make round duct of GI sheet using 'soldering' process. 2. To prepare a tray of GI by fabrication **Machine Shop:** 1. To study the working of basic machine tools like Lathe m/c, Shaper m/c, Drilling m/c and Grinding m/c. 2. To perform the following operations on Centre Lathe: Turning, Step turning, Taper turning, Facing, Grooving and Knurling 3. To perform the operations of drilling of making the holes on the given metallic work-piece (M.S.) by use of drilling machine. **Foundry Shop:** 1. To prepare core as per given size. 2. To prepare a mould for given casting.	

Evaluation Scheme of Practical Examination:

Internal Evaluation (50 marks)

Each experiment would be evaluated by the faculty concerned on the date of the experiment on a 4-point scale which would include the practical conducted by the students and a Viva taken by the faculty concerned. The marks shall be entered on the index sheet of the practical file.

Evaluation scheme:

PRACTICAL PERFORMANCE & VIVA DURING THE SEMESTER (35 MARKS)				ON THE DAY OF EXAM (15 MARKS)		TOTAL INTERNAL (50 MARKS)
EXPERIMENT (5 MARKS)	FILE WORK (10 MARKS)	VIVA (10 MARKS)	ATTENDANCE (10 MARKS)	EXPERIMENT (5 MARKS)	VIVA (10 MARKS)	

External Evaluation (50 marks)

The external evaluation would also be done by the external Examiner based on the experiment conducted during the examination.

EXPERIMENT (20 MARKS)	FILE WORK (10 MARKS)	VIVA (20 MARKS)	TOTAL EXTERNAL (50 MARKS)

Course Code: **IDS251**	**Specialization- Data Science** **B.Tech.- Semester-II** **Programming in C (Lab)**	**L-0** **T-0** **P-2** **C-1**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the basic terminology used in computer programming	
CO2.	Understanding the various concept of function in C programming.	
CO3.	Understanding the concepts of dynamic memory management.	
CO4.	Applying different data types to create C computer program.	
CO5.	Implementing the various concepts of decision structures, loops and functions in C programming.	
Course Content:		
List of Experiments	**Part A** **1.** Printing the reverse of an integer. **2.** Printing the odd and even series of N numbers. **3.** Get a string and convert the lowercase to uppercase and vice--versa using getchar() and putchar(). **4.** Input a string and find the number of each of the vowels appear in the string. **5.** Accept N words and make it as a sentence by inserting blank spaces and a full stop at the end. **6.** Printing the reverse of a string. **Part B** **1.** Searching an element in an array using pointers. **2.** Checking whether the given matrix is an identity matrix or not. **3.** Finding the first N terms of Fibonacci series. **4.** Declare 3 pointer variables to store a character, a character string and an integer respectively. **5.** Input values into these variables. Display the address and the contents of each variable. **6.** Define a structure with three members and display the same. **7.** Declare a union with three members of type integer, char, string and illustrate the use of union. **8.** Recursive program to find the factorial of an integer. **9.** Finding the maximum of 4 numbers by defining a macro for the maximum of two numbers. **10.** Arranging N numbers in ascending and in descending order using bubble sort. **11.** Addition and subtraction of two matrices. **12.** Multiplication of two matrices. **13.** Converting a hexadecimal number into its binary equivalent. **14.** Check whether the given string is a palindrome or not. **15.** Demonstration of bitwise operations. **16.** Applying binary search to a set of N numbers by using a function. **17.** Create a sequential file with three fields: empno, empname, empbasic. Print all the details in a neat format by adding 500 to their basic salary.	
Reference Books:	1. Programming in ANSI C by Balaguruswamy, 3rd Edition, 2005, Tata McGraw Hill. 2. Let us C by Yashwant Kanetka, 6th Edition, PBP Publication.	

	3. The C programming Language by Richie and Kenninghan, 2004, BPB Publication. *** Latest editions of all the suggested books are recommended.**	
E-Content Reference	1. https://www.tutorialspoint.com/cprogramming/index.htm 2. http://cslibrary.stanford.edu/101/EssentialC.pdf	

Course Code: **IDS301**	**Specialization- Data Science** **B.Tech.- Semester-III** **Introduction to Data Science**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the overview and definition of Data Science with its crucial role in current business world.	
CO2.	Understanding the importance of mathematics & Statistics in Data Science.	
CO3.	Understanding the role of machine learning techniques in Data Science and its different types.	
CO4.	Understanding the integrated role of computers and its components in Data Science	
CO5.	Understanding the flow and process model of data science project management.	
Course Content:		
Unit-1:	**Data Science - An Overview** Introduction to Data Science, Definition and description of Data Science, history and development of Data Science, terminologies related with Data Science, basic framework and architecture, difference between Data Science and business analytics, importance of Data Science in today's business world, primary components of Data Science, users of Data Science and its hierarchy, overview of different Data Science techniques, challenges and opportunities in business analytics, different industrial application of Data Science techniques.	**8 Hours**
Unit-2:	**Mathematics and Statistics in Data Science** Role of mathematics in Data Science, importance of probability and statistics in Data Science, important types of statistical measures in Data Science : Descriptive, Predictive and prescriptive statistics, introduction to statistical inference and its usage in Data Science, application of statistical techniques in Data Science, overview of linear algebra : matrix and vector theory, role of linear algebra in Data Science, exploratory data analysis and visualization techniques, difference between exploratory and descriptive statistics, EDA and visualization as key component of Data Science.	**8 Hours**
Unit-3:	**Machine Learning in Data Science** Role of machine learning in Data Science, different types of machine learning techniques and its broad scope in Data Science : Supervised, unsupervised, reinforcement and deep learning, difference between different machine learning techniques, brief introduction to machine learning algorithms, importance of machine learning in today's business, difference between machine learning classification and prediction.	**8 Hours**
Unit-4:	**Computers in Data Science** Role of computer science in Data Science, various components of computer science being used for Data Science, role of relation data base systems in	**8 Hours**

	Data Science: SQL, NoSQL, role of data warehousing in Data Science, terms related with data warehousing techniques, importance of operating concepts and memory management, various freely available software tools used in Data Science : R, Python, important proprietary software tools, different business intelligence tools and its crucial role in Data Science project presentation.	
Unit-5:	**Data Science Project Management** Data Science project framework, execution flow of a Data Science project, various components of Data Science projects, stakeholders of Data Science project, industry use cases of Data Science implementation, challenges and scope of Data Science project management, process evaluation model, comparison of Data Science project methods, improvement in success of Data Science project models.	**8 Hours**
Text Books:	1. Data Science from Scratch: First Principles with Python 1st Edition by JoelGrus.	
Reference Books:	1. Data Science For Dummies by Lillian Pierson (2015) 2. Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking by Foster Provost, Tom Fawcett 3. Data Smart: Using Data Science to Transform Information into Insight 1st Edition by John W. Foreman. (2015) Wiley Publication. 4. Principles of Data Science by SinanOzdemir, (2016) PACKT. *** Latest editions of all the suggested books are recommended.**	
E-Content Reference	1. https://www.tutorialspoint.com/python_data_science/index.htm 2. https://www.youtube.com/watch?v=u2zsY-2uZiE	

Course Code: **IDS302**	**Specialization- Data Science** **B.Tech.- Semester-III** **Statistics and Probability**	**L-2** **T-1** **P-0** **C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the basic concepts of statistics and probability.	
CO2.	Understanding the description of data using statistical techniques.	
CO3.	Understanding the statistical methods involved in hypothesis testing.	
CO4.	Understanding the difference between parametric and non-parametric tests.	
CO5.	Understanding the concepts of regression and correlation analysis.	
Course Content:		
Unit-1:	**Introduction to Statistics and Probability** History and evolution of statistics, types of data, important terminologies, contingency table, frequency and cross table, graphs, histogram and frequency polygon, Random variables, statistical properties of random variables, Expectation, , jointly distributed random variables, moment generating function, characteristic function, limit theorems, probability, trial, events, types of events, apriori probability, limitations of classical probability, statistical or empirical probability, axiomatic approach to probability, probability function, theorems on probabilities of events, law of probability theory, Bayes theorem, application of Bayes Theorem.	**8 Hours**
Unit-2:	**Measures of Central Tendency and Dispersion** Descriptive Statistics, Mean, median and mode, mathematical relationship among different means, median for raw data and grouped data, mode for raw data and grouped data, relationship among mean, median and mode, measure of dispersion – standard deviation, variance, covariance and its properties, coefficient of variation, quartiles, quartile deviation and mean deviation, Mean absolute deviation.	**8 Hours**
Unit-3:	**Testing of Hypothesis** Introduction to testing of hypothesis, Statistical assumptions, Level of significance, confidence level, Type I Error, Type II error, Critical value, power of the test, Application of small sample test – t and F test, Large Sample test – Z test in Data Science Industry with small use cases (application oriented).	**8 Hours**
Unit-4:	**Analysis of Variance (ANOVA)** Introduction to general linear model, assumptions of ANOVA, factors and levels in ANOVA, layout of one way ANOVA, skeleton of one way ANOVA, multiple comparison of sample means, one way analysis of variance with unequal sample sizes, two factor analysis of variance –	**8 Hours**

	introduction and parameter estimation, two way analysis of variance with interaction, Post ANOVA: testing of hypothesis for significance of mean using Fishers Least Significance Difference test (lsd), Tukeys test, Dunnet test, Duncan Multiple Range test.	
Unit-5:	**Correlation and Regression** Introduction to bivariate statistics, Scatter plot, Correlation analysis, properties of correlation coefficient, significance of single correlation coefficient, significance of multiple correlation coefficient, concepts of multiple correlation and partial correlation, linear model, assumptions of linear model, estimation of parameters using OLS, properties of regression coefficients, significance of regression coefficient, multiple linear regression analysis, assumptions, significance of estimated parameters.	**8 Hours**
Text Books:	1. Fundamentals of mathematical statistics – SC Gupta and VK Kapoor, Sultan Chand & Sons Publication, New Delhi	
Reference Books:	1. Introduction to probability Models, Ninth Edition – Sheldon M. Ross, Elsevier Publication, Academic Press, UK 2. Introduction to Probability and Statistics for Engineers and Scientists, Third Edition - Sheldon M. Ross, Elsevier Publication, Academic Press, UK 3. An introduction to Probability and Statistical Inference – George Roussas, Academic Press *** Latest editions of all the suggested books are recommended.**	
E-Content Reference	1. https://www.tutorialspoint.com/statistics/probability.htm 2. https://www.edureka.co/blog/statistics-and-probability/ 3. https://www.youtube.com/watch?v=XcLO4f1i4Yo	

Course Code: **IDS303**	**Specialization- Data Science** **B.Tech.- Semester-III** **Data Structure Using C++**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding basic data structures such as arrays, linked lists, stacks and queue.	
CO2.	Analyzing the time and space complexities of algorithms.	
CO3.	Understanding the concept of linked list.	
CO4.	Understanding Non-linear Data Structures such as trees.	
CO5.	Understanding Algorithm for solving problems like sorting, searching, insertion and deletion of data.	
Course Content:		
Unit-1:	**Introduction to C++ and Data Structures** Object oriented paradigm - Structured vs. Object Oriented Paradigm - Elements of Object Oriented Programming – Objects – Classes - Information and its Storage representation – Storage of Information – Data Structures – Types of Data Structures - Operations on data Structures. **Linear Data Structure Using Arrays and Pointers** Definition – Terminology – One dimensional Array – Memory Allocation – Operations – Applications - Array as an ADT - Sparse Matrices - Row and Column major representation – Representing Array using Pointers. **Sorting and Searching** Sorting - Types of Sorting – Insertion – Shell – Heap – Merge – Quick sort – radix Sort. Searching – Linear Search – Binary Search – Case Study	**8 Hours**
Unit-2:	**Stacks and Queues** **Stacks –** Definition – Applications of Stacks – Representation of Stack – Representation of Stack as an ADT - Array representation. Operations on Stacks - Recursion – Evaluation of Arithmetic Expressions – Conversion of Infix to Postfix Notation – Towers of Hanoi problem. **Queues –** Definition – Representation of queues - Array representation – Operations of queues - Types of Queues – Circular queue – Definition – Operations – Applications - Deque – Definition – Operations – Applications - Priority queue - Definition – Operations – Applications – Case Study.	**8 Hours**
Unit-3:	**Linked Lists** Definitions – Types – Single Linked lists – Representation as an ADT - Operations - Circular Linked list – Operation - Double Linked Lists – Operations - Circular double linked lists - Operations – Applications of Linked lists – Sparse Matrix Manipulation – Polynomial Representation and Manipulation – Case Study	**8 Hours**
Unit-4:	**Non- linear Data Structures – Trees** Trees – Definitions and Concepts – Types of Binary trees - Operations on Binary trees – Storage Representation and manipulation of Binary Trees – Linear -	**8 Hours**

	Linked and Threaded Storage Representation for Binary trees – Conversion of General trees to Binary trees – Sequential and other Representation of trees – Applications – Manipulation of Arithmetic Expressions. AVL Trees – Single & Double Rotation – Case Study	
Unit-5:	**Graphs** Graphs and their Representation – Definition, Graph Terminology – Graph Abstract Data Types - Matrix Representation – List Structures – Other Representation - Operations – Traversals - Breadth First Search – Depth first Search – Spanning Trees – Applications – Topological Sorting – Case Study	**8 Hours**
Text Books:	1. Data Structures Using C++, VARSHA H. PATIL, Oxford University Press-2012.	
Reference Books:	1. Data Structures and Algorithm Analysis in C++, Mark Allen Weiss, Second Edition, Pearson Education Asia, 2002. 2. Data Structures, Algorithms and Applications in C++, SartajSahni, Second Edition, Universities Press India Private Limited, 2005. 3. Data Structures Using C++, D.S. MALIK, SECOND EDITION,Cengage Learning, 2009. *** Latest editions of all the suggested books are recommended.**	
E-Content Reference	1. https://www.tutorialspoint.com/cplusplus/cpp_data_structures.htm 2. https://www.includehelp.com/data-structure-tutorial/ 3. https://www.youtube.com/watch?v=AT14lCXuMKI&list=PLdo5W4Nhv31bbKJzrsKfMpo_grxuLl8LU	

Course Code: **IDS304**	**Specialization- Data Science** **B.Tech.- Semester-III** **Computer Architecture & Organisation**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the register transfer and micro-operation.	
CO2.	Understanding the basic computer organization.	
CO3.	Identifying the various modes of data transfer.	
CO4.	Understanding the system architecture of multiprocessor and multicomputer.	
CO5.	Classifying the memory organization and I/O systems.	
Course Content:		
Unit-1:	**Register Transfer and Micro-operation** Register Transfer Language, Register Transfer, Bus and Memory Transfer: Three state bus buffers, Memory Transfer. Arithmetic Micro-operations: Binary Adder, Binary Adder-Subtrator, Binary Incrementor, Logic Micro-operations: List of Logic micro operations, Shift Micro-operations (excluding H/W implementation), Arithmetic Logic Shift Unit.	**8 Hours**
Unit-2:	**Basic Computer Organization** Instruction Codes, Computer Registers: Common bus system, Computer Instructions: Instruction formats, Instruction Cycle: Fetch and Decode, Flowchart for Instruction cycle, Register reference instructions.	**8 Hours**
Unit-3:	**Micro Programmed Control Unit** Control Memory, Address Sequencing, Conditional branching, Mapping of instruction, Subroutines, Design of Control Unit, Central Processing Unit: Introduction, General Register Organization, Stack Organization: Register stack, Memory stack; Instruction Formats, Addressing Modes.	**8 Hours**
Unit-4:	**Computer Arithmetic** Introduction, Addition and Subtraction, Multiplication Algorithms (Booth algorithm), Division Algorithms, Input – Output Organization: Peripheral devices, Input – Output interface, Introduction of Multiprocessors: Characteristics of multi-processors	**8 Hours**
Unit-5:	**Modes of Data Transfer and Memory Organization** Modes of Data Transfer: Priority Interrupt, Direct Memory Access, Memory Organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory	**8 Hours**
Text Books:	1. Computer System Architecture by Morris Mano, PHI	
Reference Books:	1. Digital Computer Electronics: An Introduction to Microcomputers by Malvino, TMH 2. PC Hardware in a Nutshell by Barbara Fritchman Thompson, Robert Bruce Thompson, O'Reilly, 2nd Edition , 2010 3. Fundamentals of Computer Organization and Architecture by Mostafa AB-EL-BARR and Hesham EL-REWNI, John Wiley and Sons 4. Fundamental Of computer Organization by Albert Zomaya, 2010	

	*** Latest editions of all the suggested books are recommended.**	
E-Content Reference	1. https://www.geeksforgeeks.org/computer-organization-and-architecture-tutorials/ 2. http://www.svecw.edu.in/Docs%5CITIIBTechIISemLecCOA.pdf	

Course Code: **IDS305**	**Specialization- Data Science** **B.Tech.- Semester-III** **Object Oriented Programming using Java**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding of Java-based software code of medium-to-high complexity.	
CO2.	Understanding of the basic principles of creating Java applications with graphical user interface (GUI).	
CO3.	Understanding of the fundamental concepts of computer science: structure of the computational process, algorithms and complexity of computation.	
CO4.	Understanding the basic approaches to the design of software applications.	
CO5.	Applying various programming concepts to create a Java application.	
Course Content:		
Unit-1:	**Introduction** History and Overview of Java, Object Oriented Programming, Control statements- if and for loop. Using Blocks of codes, Lexical issues - White space, identifiers, Literals, comments, separators, Java Key words, Data types - Integers, Floating point, characters, Boolean, A closer look at Literals, Variables, Type conversion and casting. Automatic type promotion in Expressions Arrays. Operators - Arithmetic operators, Bit wise operators, Relational Operators, Boolean Logical operators, Assignment Operator, Operator Precedence. Control Statements – Selection Statements - if, Switch, Iteration Statements - While, Do-while, for Nested loops, Jump statements.	**8 Hours**
Unit-2:	**Classes** Class Fundamentals, Declaring objects, Assigning object reference variables. Methods - constructors, "this" keyword, finalize ( ) method A stack class, Over loading methods. Using objects as parameters, Argument passing, Returning objects. Recursion, Access control, Introducing final, understanding static. Introducing Nested and Inner classes. Using command line arguments. Inheritance – Basics, Using super, method overriding, and Dynamic method Dispatch, Using abstract classes and final with Inheritance.	**8 Hours**
Unit-3:	**Packages** Definition. Access protection importing packages. Interfaces: Definition and implementation. Exception Handling – Fundamentals, types, Using try and catch and Multiple catch clauses, Nested try Statements, throw, throws, finally. Java's built-in exception, using Exceptions.	**8 Hours**
Unit-4:	**Multithreaded Programming:** Java thread model – main thread, creating single and multiple thread. Is alive ( ) and join ( ). Thread – Priorities, Synchronization, Inter thread communication, suspending, resuming and stopping threads, using multi-	**8 Hours**

	threading. I / O basics – Reading control input, writing control output, Reading and Writing files. Applet Fundamentals – AWT package, AWT Event handling concepts, the transient and volatile modifiers. Using instance of using assert.	
Unit-5:	**JAVA Database Connectivity (JDBC)** Database connectivity – JDBC architecture and Drivers. JDBC API - loading a driver, connecting to a database, creating and executing JDBC statements, handling SQL exceptions. Accessing result sets: types and methods. An example - JDBC application to query a database.	**8 Hours**
Text Books:	1. The complete reference Java –2: V Edition by Herbert Schildt Pub. TMH.	
Reference Books:	1. SAMS teach yourself Java – 2: 3rd Edition by Rogers Cedenhead and Leura Lemay Pub. Pearson Education. 2. Introduction to Java Programming (Comprehensive Version), Daniel Liang, Seventh Edition, Pearson 3. Core Java Volume-I Fundamentals, Eight Edition, Horstmann & Cornell, Pearson Education *** Latest editions of all the suggested books are recommended.**	
E-Content References	1. https://www.javatpoint.com/java-tutorial 2. https://www.iitk.ac.in/esc101/share/downloads/javanotes5.pdf	

Course Code: IDS306	**Specialization- Data Science** **B.Tech.- Semester-III** **Effective Communication Skills**	**L-1 T-0 P-2 C-2**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the art of public speaking and strategies of reading comprehension.	
CO2.	Understanding the essentials of effective listening and speaking.	
CO3.	Applying correct vocabulary and sentence construction during public speaking or professional writing.	
CO4.	Analyzing different types of sentences like simple, compound and complex.	
CO5.	Demonstrating speaking skills during common conversation and power point presentation.	
Course Content:		
Unit-1:	**Communication Process** Importance of effective communication skills in the business world, Components of Communication Process, practicing effective communication.	**8 Hours**
Unit-2:	**Types of Communication & Barriers to communication** Verbal Communication, Non Verbal Communication, Written Communication, Do's and don'ts of each type, barriers to effective communication and how to overcome them.	**8 Hours**
Unit-3:	**Listening Skills & Reading Skills** What is listening, various types of listening – Active, passive, selective. Techniques to develop effective listening skills, Reading Skills- skimming, scanning and inferring- common reading techniques, practicing smart reading	**8 Hours**
Unit-4:	**Conversation Skills.** Importance of conversation skills, features of a good conversation, Tips to improve Conversation skills, importance of questioning skills, techniques to ask right questions- role play situations to practice the same.	**8 Hours**
Unit-5:	**Telephone Etiquette** Basic rules of telephone etiquette- formal vs. informal; tone, pitch and vocabulary related to formal ways of speaking over the phone, leaving voice messages; practice sessions (role plays)	**8 Hours**
Text Books:	1. Active Listening 101: How to Turn Down Your Volume to Turn Up Your Communication Skills, by Emilia Hardman, 2012	
Reference Books:	1. Power Listening: Mastering the Most Critical Business Skill of All, by Bernard T. Ferrari, 2012 2. Fitly Spoken: Developing Effective Communication and Social Skills, by Greg S. Baker, 2011 3. The Secrets of Successful Communication: A Simple Guide to Effective Encounters in Business (Big Brain vs. Little Brain Communication), by Kevin T. McCarney, 2011. *** Latest editions of all the suggested books are recommended.**	

E-Content References	1. https://www.tutorialspoint.com/effective_communication/effective_communication_tutorial.pdf 2. https://www.manage.gov.in/studymaterial/EC.pdf	

Course Code: IDS351	**Specialization- Data Science** **B.Tech.- Semester-III** **Data Structure Using C++ (Lab)**	**L-0 T-0 P-4 C-2**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding appropriate data structures as applied to specified problem definition	
CO2.	Applying various programming approaches to solve data structure problems.	
CO3.	Analyzing various data structure algorithms.	
CO4.	Creating appropriate searching technique for given problem.	
CO5.	Creating appropriate sorting technique for given problem.	
Course Content:		
List of Experiments:	1. Manipulate data elements like adding, deleting and searching elements using Arrays. 2. Perform stack operations using Classes. 3. Evaluate postfix expression for simple binary arithmetic operations using stack. 4. Perform operations of a Circular Queue using classes and linked list. 5. Perform operations on Single Linked list using classes. 6. Perform operations on doubly linked list using classes. 7. Implement of Polynomial Manipulation using Linked list. 8. Construct a binary tree and perform all traversal operations. 9. Implement C++ program to perform graph traversals. **10.** Implement C++ program for Quick Sort and Binary Search using classes.	
Text Books:	1. Data Structures Using C++, VARSHA H. PATIL, Oxford University Press-2012.	
Reference Books:	1. Data Structures and Algorithm Analysis in C++, Mark Allen Weiss, Second Edition, Pearson Education Asia, 2002. 2. Data Structures, Algorithms and Applications in C++, SartajSahni, Second Edition, Universities Press India Private Limited, 2005. 3. Data Structures Using C++, D.S. MALIK, SECOND EDITION,Cengage Learning, 2009. *** Latest editions of all the suggested books are recommended.**	
E-Content Reference	1. https://www.tutorialspoint.com/cplusplus/cpp_data_structures.htm 2. https://www.includehelp.com/data-structure-tutorial/ 3. https://www.youtube.com/watch?v=AT14lCXuMKI&list=PLdo5W4Nhv31bbKJzrsKfMpo_grxuLl8LU	

Course Code: **IDS352**	**Specialization- Data Science** **B.Tech.- Semester-III** **Object Oriented Programming using Java Lab**	**L-0** **T-0** **P-4** **C-2**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the concepts of OOPs in Java	
CO2.	Understanding the concepts abstract classes and string operations.	
CO3.	Applying the various programming concepts to solve given problems.	
CO4.	Creating the Applet using java programs.	
CO5.	Creating the Client Server Communication using Socket Programming.	
Course Content:		
	Part A 1. Write a program to check whether two strings are equal or not. 2. Write a program to display reverse string. 3. Write a program to find the sum of digits of a given number. 4. Write a program to display a multiplication table. 5. Write a program to display all prime numbers between 1 to 1t000. 6. Write a program to insert element in existing array. 7. Write a program to sort existing array. 8. Write a program to create object for Tree Set and Stack and use all methods. 9. Write a program to check all math class functions. 10. Write a program to execute any Windows 95 application (Like notepad, calculator etc) 11. Write a program to find out total memory, free memory and free memory after executing garbage Collector (gc). **Part B** 1. Write a program to copy a file to another file using Java to package classes. Get the file names at run time and if the target file is existed then ask confirmation to overwrite and take necessary actions. 2. Write a program to get file name at runtime and display number f lines and words in that file. 3. Write a program to list files in the current working directory depending upon a given pattern. 4. Create a textfileld that allows only numeric value and in specified	**8 Hours**

	length. **5.** Create a Frame with 2 labels, at runtime display x and y command-ordinate of mouse pointer in the labels.	
Text Books:	2. The complete reference Java –2: V Edition by Herbert Schildt Pub. TMH.	
Reference Books:	4. SAMS teach yourself Java – 2: 3rd Edition by Rogers Cedenhead and Leura Lemay Pub. Pearson Education. 5. Introduction to Java Programming (Comprehensive Version), Daniel Liang, Seventh Edition, Pearson 6. Core Java Volume-I Fundamentals, Eight Edition, Horstmann & Cornell, Pearson Education *** Latest editions of all the suggested books are recommended.**	
E-Content References	3. https://www.javatpoint.com/java-tutorial 4. https://www.iitk.ac.in/esc101/share/downloads/javanotes5.pdf	

Course Code: **IDS353**	**Specialization- Data Science** **B.Tech.- Semester-III** **Project**	**L-0** **T-0** **P-2** **C-1**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding methodologies and professional way of documentation and communication.	
CO2.	Understanding about software development cycle with emphasis on different processes -requirements, design, and implementation phases.	
CO3.	Analyzing a software project and demonstrate the ability to communicate effectively in speech and writing.	
CO4.	Creating a new model over the selected field of research that will be useful for future activities.	
CO5.	Creating a project that help to gain confidence and technical knowledge.	
Course Content:		
Guidelines for Seminar:	● **Selection of topic:** All students who are pursuing B.Tech shall submit the proposed topic of the seminar in the first week of the semester to the course coordinator. Care should be taken that the topic selected does not directly relate to the course of the courses being pursued. The course coordinator shall then forward the list to the concerned Seminar Committee. The topics will then be allocated to the students along with the name of the faculty guide. **Preparation of the seminar** 1. The student shall meet the guide for the necessary guidance for the seminar work. 2. During the next two to four weeks the student should read the primary literature germane to the seminar topic. Reading selection should continuously be informed to the guide. 3. After necessary collection of data and literature survey, the students must prepare a report. The report shall be arranged in the sequence consisting of the following:- a. Top Sheet of transparent plastic. b. Top cover. c. Preliminary pages. i. Title page ii. Certification page. iii. Acknowledgment. iv. Abstract. v. Table of Content. vi. List of Figures and Tables. d. Chapters (Main Material). e. Appendices, If any. f. Bibliography/ References. g. Back Cover (Blank sheet).	**8 Hours**

h. Back Sheet of Plastic (May be opaque or transparent).

For Guide

If you choose not to sign the acceptance certificate, please indicate reasons for the same from amongst those given below:

i) The amount of time and effort put in by the student is not sufficient;

ii) The amount of work put in by the student is not adequate

iii) The report does not represent the actual work that was done / expected to be done;

iii) Any other objection (Please elaborate)

General points for the seminar

1. The report should be typed on A4 sheet. The Paper should be of 70-90 GSM.
2. Each page should have minimum margins as under
a. Left 1.5 inches
b. Right 0.5 Inches
c. Top 1 Inch
d. Bottom 1 Inch (Excluding Footer, If any)
3. The printing should be only on one side of the paper
4. The font for normal text should Times New Roman, 12 size for text and 14 size for heading and should be typed in double space. The references may be printed in Italics or in a different font.
5. The Total Report should not exceed 30 pages including top cover and blank pages.
6. One copy completed in all respect as given above is to be submitted to the guide. That will be kept in departmental/University Library.
7. The power point presentation should not exceed 15 minutes which include 5 minutes for discussion/Viva.

Seminar will be evaluated out of total 100 marks. In Internal Evaluation marks will be awarded out of 50 and in external evaluation also marks will be awarded out of 50 on the basis of viva voce. Internal evaluation will be exercised by the Internal Evaluation Committee of college.

Guidelines for Project :

Students will have to undergo industrial training of six weeks in any industry or reputed organization after the IV semester examination in summer. The evaluation of this training shall be included in the V semester evaluation. The student will be assigned a faculty guide who would be the supervisor of the student. The faculty would be identified before the end of the IV semester and shall be the nodal officer for coordination of the training. Students will prepare an exhaustive technical report of the training during the V semester which will be duly signed by the officer under whom training was undertaken in the industry/ organization. The covering format shall be signed by the concerned office in-charge of the training in the industry. The officer-in-charge of the trainee would also give his rating of the student in the standard University format in a sealed envelope to the Principal of the college. The student at the end of the V semester will present his report about the training before a committee constituted by the Director of the College which would comprise of at least three members comprising of the Department Coordinator, Class Coordinator and a nominee of the

	Director. The students guide would be a special invitee to the presentation. The seminar session shall be an open house session. The internal marks would be the average of the marks given by each member of the committee separately in a sealed envelope to the Director. The marks by the external examiner would be based on the report submitted by the student which shall be evaluated by the external examiner and cross examination done of the student concerned. Not more than three students would form a group for such industrial training/ project submission. **The marking shall be as follows.** Internal: 50 Marks By the faculty guide - 25 marks By committee appointed by the director – 25 marks External: 50 Marks By officer-in-charge trainee in industry – 25 marks By external examiner appointed by the university – 25 marks	

Course Code: TMUGA301	**Specialization- Data Science** **B.Tech.- Semester-III** **Foundation in Quantitative Aptitude (Value Added Course)**	**L-2 T-1 P-0 C-0**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Solving complex problems using Criss cross method, base method and square techniques.	
CO2.	Applying the arithmetical concepts of Average, Mixture and Allegation.	
CO3.	Evaluating the different possibilities of various reasoning based problems in series, Blood relation, Ranking and Direction.	
CO4.	Operationalizing the inter-related concept of Percentage in Profit Loss and Discount, Si/CI and Mixture/Allegation.	
Course Content:		
Unit-1:	**Speed calculations** Squares till 1000,square root, multiplications: base 100, 200 300 etc., 11-19, crisscross method for 2X2, 3X3, 4X4, 2X3, 2X4 etc., cubes, cube root	**3 Hours**
Unit-2:	**Percentages** Basic calculation, ratio equivalent, base, change of base, multiplying factor, percentage change, increment, decrement, successive percentages, word problems	**5 Hours**
Unit-3:	**Profit Loss Discount** Basic definition, formula, concept of mark up, discount, relation with successive change, faulty weights	**5 Hours**
Unit-4:	**SI and CI** Simple Interest, finding time and rate, Compound Interest, difference between SI and CI, Installments	**4 Hours**
Unit-5:	**Averages** Basic Averages, Concept of Distribution, Weighted Average, equations	**3 Hours**
Unit-6:	**Mixtures and allegations** Mixtures of 2 components, mixtures of 3 components, Replacements	**5 Hours**
Unit-7:	**Blood relations** Indicating type, operator type, family tree type	**3 Hours**
Unit-8:	**Direction sense** Simple statements, shadow type	**2 Hours**
Reference Books:	• R1:-Arun Shrama:- How to Prepare for Quantitative Aptitude • R2:-Quantitative Aptitude by R.S. Agrawal • R3:-M Tyra: Quicker Maths • R4:-Nishith K Sinha:- Quantitative Aptitude for CAT • R5:-Reference website:- Lofoya.com, gmatclub.com, cracku.in, handakafunda.com, tathagat.mba, Indiabix.com • R6:-Logical Reasoning by Nishith K Sinha • R7:-Verbal and Non Verbal Reasoning by R.S. Agrawal *** Latest editions of all the suggested books are recommended.**	

Course Code: IDS401	**Specialization- Data Science** **B.Tech.- Semester-IV** **Python Programming for Data Science**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the history and development of Python Programming Language.	
CO2.	Understanding the data structures and looping concepts in Python Programming Language.	
CO3.	Understanding the important packages and functions in Python Programming Language.	
CO4.	Understanding the importance of Python Programming Language in data wrangling or munging.	
CO5.	Analysing the impact of Python Programming Language in statistical analysis.	
Course Content:		
Unit-1:	**Introduction to Python Environment** History and development of Python, Why Python? Grasping Python's core philosophy, Discovering present and future development goals, Working with Python : Getting a taste of the language, Understanding the need for indentation, Working at the command line or in the IDE, Visualizing Power, Using the Python Ecosystem for Data Science, Accessing scientific tools using SciPy, Performing fundamental scientific computing using NumPy, Performing data analysis using pandas, Implementing machine learning using Scikit- learn, Plotting the data using matplotlib, Parsing HTML documents using Beautiful Soup, Setting Up Python for Data Science, Getting Continuum Analytics Anaconda, Getting Enthought Canopy Express, Getting pythonxy, Getting WinPython, Installing Anaconda on Windows, Linux and MAC	**8 Hours**
Unit-2:	**Data Structures, Looping and Branching** Working with Numbers and Logic, Performing variable assignments, Doing arithmetic, Comparing data using Boolean expressions, Creating and Using Strings, Interacting with Dates, Creating and Using Functions, Calling functions in a variety of ways, Using Conditional and Loop Statements, Making decisions using the if statement, Choosing between multiple options using nested decisions, Performing repetitive tasks using for, Using the while statement, Storing Data Using Sets, Lists, and Tuples : Performing operations on sets, Working with lists, Creating and using Tuples, Defining Useful Iterators, Indexing Data Using Dictionaries.	**8 Hours**
Unit-3:	**Data Management** Working with Real Data, Working with Real Data, Uploading small amounts of data into memory, Streaming large amounts of data into memory, Sampling data, Accessing Data in Structured Flat- File Form, Sending Data in Unstructured File Form, Managing Data from Relational Databases, Interacting with Data from NoSQL Databases, Accessing Data from the Web, Juggling between NumPy and pandas, Validating Your Data, Removing duplicates, Manipulating Categorical	**8 Hours**

	Variables, Dealing with Dates in Your Data, Dealing with Missing Data, Slicing and Dicing: Filtering and Selecting Data, Concatenating and Transforming Working with HTML Pages, Working with Raw Text, Working with Graph Data.	
Unit-4:	**Data Transformation** Understanding classes in Scikit- learn, Playing with Scikit- learn, Defining applications for data science, Performing the Hashing Trick, Using hash functions, Demonstrating the hashing trick, Working with deterministic selection, Considering Timing and Performance, Benchmarking with timeit, Working with the memory profiler, Performing multicore parallelism, Demonstrating multiprocessing.	**8 Hours**
Unit-5:	**Python for Statistics** Exploring Data Analysis, The EDA Approach, Defining Descriptive Statistics for Numeric Data, Measuring central tendency, Measuring variance and range, Working with percentiles, Defining measures of normality, Counting for Categorical Data, Understanding frequencies, Creating contingency tables, Creating Applied Visualization for EDA, Inspecting boxplots, Performing t- tests after boxplots, Observing parallel coordinates, Graphing distributions, Plotting scatterplots, Using covariance and correlation, Using nonparametric correlation, Considering chi- square for tables, Using the normal distribution, Creating a Z-score standardization, Transforming other notable distributions, Detecting Outliers in Data, Clustering, Reducing dimensionality.	**8 Hours**
Text Books:	1. Python for Data Science for Dummies - Luca Massaron and John Paul Mueller, John Wiley & Sons, Inc.	
Reference Books:	1. Python for Data Analysis - Wes McKinney, O'Reilly Media, Inc. 2. Data Science from Scratch - Joel Grus, O'Reilly Media, Inc. 3. Python Scripting for Computational Science - Hans Petter Langtangen *** Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference Material:	1. https://www.tutorialspoint.com/python_data_science/index.htm 2. http://dl.booktolearn.com/ebooks2/computer/python/9781498742092_Data_Science_and_Analytics_with_Python_2b29.pdf	

Course Code: IDS402	**Specialization- Data Science** **B.Tech.- Semester-IV** **Sampling Methods**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the important terminologies and need for sampling over complete enumeration.	
CO2.	Understanding the need for learning and sampling proportion in sampling theory.	
CO3.	Understanding the concepts of mean and variance used in Data samples.	
CO4.	Understanding the concepts of systematic random sampling.	
CO5.	Applying the various data sampling method to analyze the sample data.	
Course Content:		
Unit-1:	**Introduction to Sampling** Introduction, important terminologies related with sampling methods: samples, population, standard error, sampling distribution, sample size, need for sampling, advantages and disadvantages of sampling, important principle steps in sample survey, sample survey vs complete enumeration, the role of sampling theory, probability sampling, alternative to probability sampling, importance of normal distribution in sampling theory, bias and its effects in sampling process, role of mean square error in sampling theory.	**8 Hours**
Unit-2:	**Sampling proportions and Percentages** Introduction, Qualitative characteristics of samples, variances of the sample estimates, the effect of P on the standard errors, probability distribution function: the binomial probability distribution, the hypergeometric distribution, confidence limits, classification into more than two classes, confidence limits with more than two classes, the conditional distribution of p, proportions and totals over subpopulation, comparison between different domains.	**8 Hours**
Unit-3:	**Simple Random Sampling** Introduction, need for simple random sampling, overview and definition of simple random sampling with and without replacement, selection of a simple random sample, definitions and notations conventions in simple random sampling, properties of the estimates, variances of the estimates, the finite population correction, estimation of standard error from the samples, confidence limits, estimation of a ratio, estimates of means over subpopulation, estimates of totals over sub population, comparison between domain means, validity of normal approximation, linear estimates of the population mean.	**8 Hours**
Unit-4:	**Stratified and Systemic Random Sampling** Definition and overview of stratified and systemic random sampling, properties of the estimates, estimated variance and confidence limits, proportional allocation, optimum allocation, Neyman Allocation, relative	**8 Hours**

	precision of stratified sampling over simple random sampling, allocation requires more than 100 percent sampling, , Choice of Sample Sizes in Different Strata, advantages and disadvantages of stratified sampling, Systematic Sampling: The Sample Mean and its Variance, Comparison of Systematic with Random Sampling, Comparison of Systematic with Stratified Random Sampling, Estimation of the Variance, two stage sample with equal and unequal units.	
Unit-5:	**Cluster Sampling** Equal Clusters: Introduction, definition, efficiency of cluster sampling, Efficiency of Cluster Sampling in Terms of Intra-Class Correlation, Estimation from the Sample of the Efficiency of Cluster Sampling, Relationship between the Variance of the Mean of a Single Cluster and its Size, Optimum Unit of Sampling and Multipurpose Surveys, Unequal Clusters: Estimates of the Mean and their Variances, Probability Proportional to Cluster Size: Estimate of the Mean and its Variance, Probability Proportional to Cluster Size: Efficiency of Cluster Sampling, Probability Proportional to Cluster Size: Relative Efficiency of Different Estimates.	**8 Hours**
Text Books:	1. Sampling Theory of Survey with Applications - Pandurang V Sukhatme, Indian society of Agricultural Statistics, New Delhi.	
Reference Books:	1. Large Sample Techniques - Jiming Jiang, Springer 2. Sampling Methods: Pascal Ardilly Yves Tillé - Springer 3. Sampling Techniques, William G. Cochran, Third Edition, Wiley Publications. *** Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference Material:	1. http://home.iitk.ac.in/~shalab/course1.htm 2. https://www.nass.usda.gov/Education_and_Outreach/Reports,_Presentations_and_Conferences/Survey_Reports/Introductory%20Theory%20for%20Sample%20Surveys%20(Pages%201-100).pdf	

Course Code: **IDS403**	**Specialization- Data Science** **B.Tech.- Semester-IV** **Relational Database Management System**	**L-3** **T-0** **P-0** **C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the basic concepts of database management system.	
CO2.	Understanding the concepts DBMS and RDBMS.	
CO3.	Understanding various Structure Query Languages and various Normal forms to carry out Schema refinement.	
CO4.	Understanding the concepts of various concurrency control protocols.	
CO5.	Creating Entity-Relationship Model for enterprise level databases.	
Course Content:		
Unit-1:	**Introduction** Purpose of Database System -– Views of data – Data Models – Database Languages –– Database System Architecture – Database users and Administrator – Entity– Relationship model (E-R model) – E-R Diagrams -- Introduction to relational databases	**8 Hours**
Unit-2:	**Relational Model** The relational Model – The catalog- Types– Keys - Relational Algebra – Domain Relational Calculus – Tuple Relational Calculus - Fundamental operations – Additional Operations- SQL fundamentals, Oracle data types, Data Constraints, Column level & table Level Constraints, working with Tables, Defining different constraints on the table, Defining Integrity Constraints in the ALTER TABLE Command, Select Command, Logical Operator, Range Searching, Pattern Matching, Oracle Function, Grouping data from Tables in SQL, Manipulation Data in SQL.	**8 Hours**
Unit-3:	**SQL** Joining Multiple Tables (Equi Joins), Joining a Table to itself (self Joins), Sub queries Union, intersect & Minus Clause, Creating view, Renaming the Column of a view, Granting Permissions, - Updating, Selection, Destroying view Creating Indexes, Creating and managing User, Integrity – Triggers - Security – Advanced SQL features –Embedded SQL– Dynamic SQL- Missing Information– Views – Introduction to Distributed Databases and Client/Server Databases	**8 Hours**
Unit-4:	**Database Design** Functional Dependencies – Non-loss Decomposition – Functional Dependencies – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form-Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form	**8 Hours**

Unit-5:	**Transactions** Transaction Concepts - Transaction Recovery – ACID Properties – System Recovery – Media Recovery – Two Phase Commit - Save Points – SQL Facilities for recovery –Concurrency – Need for Concurrency – Locking Protocols – Two Phase Locking – Intent Locking – Deadlock-Serializability – Recovery Isolation Levels – SQL Facilities for Concurrency.	**8 Hours**
Text Books:	1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Fifth Edition, Tata McGraw Hill, 2006	
Reference Books:	1. Raghu Ramakrishnan, "Database Management Systems", Third Edition, McGraw Hill, 2003. 2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Fourth Edition, Pearson/Addision Wesley, 2007. *** Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference Material:	1. https://www.javatpoint.com/dbms-tutorial 2. http://www.ddegjust.ac.in/studymaterial/mca-3/ms-11.pdf	

Course Code: IDS404	**Specialization- Data Science** **B.Tech.- Semester-IV** **Operating System**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the fundamental concepts in Operating system	
CO2.	Understanding evolution of OS over the years and different components of OS	
CO3.	Understanding the significant functions of OS like Process management, storage and memory management etc.	
CO4.	Understanding the necessary information of the OS while developing programs, working with applications and etc.	
CO5.	Analysing the different type of Operating System and their working.	
Course Content:		
Unit-1:	**Introduction to Operating System:** Introduction, Objectives and Functions of OS, Evolution of OS, OS Structures, OS Components, OS Services, System calls, System programs, Virtual Machines.	**8 Hours**
Unit-2:	**Process Management:** Processes: Process concept, Process scheduling, Co-operating processes, Operations on processes, Inter process communication, Communication in client-server systems. Threads: Introduction to Threads, Single and Multi-threaded processes and its benefits, User and Kernel threads, Multithreading models, threading issues. CPU Scheduling: Basic concepts, Scheduling criteria, Scheduling Algorithms, Multiple Processor Scheduling, Real-time Scheduling, Algorithm Evaluation, Process Scheduling Models. Process Synchronization: Mutual Exclusion, Critical – section problem, Synchronization hardware, Semaphores, Classic problems of synchronization, Critical Regions, Monitors, OS Synchronization, Atomic Transactions Deadlocks: System Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.	**8 Hours**
Unit-3:	**Storage Management:** Memory Management: Logical and physical Address Space, Swapping, Contiguous Memory Allocation, Paging, And Segmentation with Paging. Virtual Management: Demand paging, Process creation, Page Replacement Algorithms, Allocation of Frames, Thrashing, Operating System Examples, Page size and other considerations, Demand segmentation File-System Interface: File concept, Access Methods, Directory structure, File- system Mounting, File sharing, Protection and consistency semantics.	**8 Hours**
Unit-4:	**File-System Implementation:** File-System structure, File-System Implementations, Directory Implementation, Allocation Methods, Free-space Management, Efficiency and Performance, Recovery Disk Management: Disk Structure, Disk Scheduling, Disk Management, Swap-Space Management, Disk Attachment, stable-storage Implementation**.**	**8 Hours**

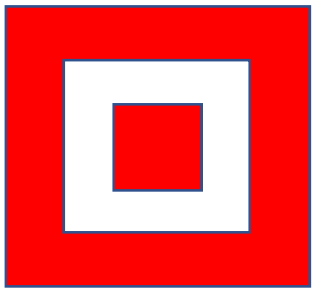
Unit-5:	**Protection and Security:** Protection: Goals of Protection, Domain of Protection, Access Matrix, and Implementation of Acess Matrix, Revocation of Access Rights, Capability- Based Systems, and Language – Based Protection. Security: Security Problem, User Authentication, One – Time Password, Program Threats, System Threats, Cryptography, Computer – Security Classifications.	**8 Hours**
Text Books:	1. Silberschatz / Galvin / Gagne, Operating System,6thEdition,WSE (WILEY Publication)	
Reference Books:	1. William Stallings,Operating System, 4th Edition, Pearson Education. 2. Milan Milonkovic, Operating System Concepts and design, II Edition, McGraw Hill 1992. 3. Tanenbaum, Operation System Concepts, 2nd Edition, Pearson Education. 4. Operating Systems by Nutt, 3/e Pearson Education 2004 *** Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference Material:	1. https://www.javatpoint.com/os-tutorial 2. http://mailamtamilartscollege.com/EContent/ComputerScience/OPERATING-SYSTEM.pdf	

Course Code: IDS405	**Specialization- Data Science** **B.Tech.- Semester-IV** **Personality Development**	**L-2 T-0 P-2 C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the various components of Personality development.	
CO2.	Understanding the importance of time management.	
CO3.	Applying the skills more effectively in team building and resolving conflicts both in personal and professional life.	
CO4.	Analyzing the various skills related to Personality Development.	
CO5.	Come out as more confident individuals with a lot of clarity and maturity in making decisions.	
Course Content:		
Unit-1:	**Personality & Self Esteem** Definition of personality, Components of Personality- Values- Beliefs & experiences, Definition of Self Esteem, Factors related to self-esteem, SWOT analysis, Building Self Esteem, Importance of A-S-K concept in personality development, Definition of Attitude, Skills & Knowledge.	**8 Hours**
Unit-2:	**Interpersonal Skills & Working In team** What are interpersonal skills? Importance of Interpersonal Skills in the Business world, How to build relationships, What is a team, Significance of working in team, Qualities required to be an effective Team Member, Skills required to build an effective TEAM	**8 Hours**
Unit-3:	**Time Management & Planning** Time as a resource, individual understanding of time, Effective time management Techniques, identifying time waster, achieving goals through effective time management	**8 Hours**
Unit-4:	**Problem Solving & Decision Making** What is a problem? Different stages of resolving a problem, Different factors that influence decision making, Different stages of decision making	**8 Hours**
Unit-5:	**Conflict Management** What is a conflict?, Consequences of Conflict – Good & Bad, main sources of Conflict, Techniques to handle conflicts – Lose – win, Lose- Lose, Win – Lose, WIN- WIN.	**8 Hours**
Text Books:	1. Personality Development across the life span Edited by Jule Specht\Academic Press	
Reference Books:	1. Personality Development & Soft Skills,Barun K. Mitra,Oxford University Press	
Additional Electronic Reference Material:	1. https://www.staticcontents.youth4work.com/university/Documents/Colleges/CollegeSummaryAttach/29f57018-6412-4dee-b24b-ac29e54a0f9e.pdf 2. https://www.bharathuniv.ac.in/colleges1/downloads/courseware_ece/notes/BSS201%20-%20PERSONALITY.pdf	

Course Code: **IDS451**	**Specialization- Data Science** **B.Tech.- Semester-IV** **Relational Database Management System(LAB)**	**L-0** **T-0** **P-4** **C-2**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the database language commands to create simple database.	
CO2.	Understanding the database using queries to retrieve records.	
CO3.	Applying PL/SQL Commands for database processing.	
CO4.	Applying the JOIN, UNION and GROUPBY techniques in DBMS operation.	
CO5.	Creating solutions using database concepts for real time requirements.	
Course Content:		
List of Experiments:	1. SQL Commands a. Data Definition Language commands, b. Data Manipulation Language commands, c. Data Control Language commands and d. Transaction Control Language commands 2. Select Statements with all clauses/options 3. Nested Queries 4. Join Queries 5. Views 6. High level programming language extensions (Control structures, Procedures and Functions) 7. Database Design and implementation (Mini Project)	
Text Books:	1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Fifth Edition, Tata McGraw Hill, 2006	
Reference Books:	1. Raghu Ramakrishnan, "Database Management Systems", Third Edition, McGraw Hill, 2003. 2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Fourth Edition, Pearson/Addision Wesley, 2007. *** Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference Material:	1. https://www.javatpoint.com/dbms-tutorial 2. http://www.ddegjust.ac.in/studymaterial/mca-3/ms-11.pdf	

Course Code: **IDS452**	**Specialization- Data Science** **B.Tech.- Semester-IV** **Python Programming for Data Science (Lab)**	**L-0 T-0 P-4 C-2**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding various solutions to simple computational problems using Python programs.	
CO2.	Applying conditional statements and loops in Python to Solving problems.	
CO3.	Applying various ML algorithms on given data sets.	
CO4.	Creating Python programs by defining functions and calling them.	
CO5.	Creating Python lists, tuples and dictionaries for representing compound data.	
Course Content:	**Perform any ten experiments selecting at least one from each shop**	
List of Experiments:	1. Write and run a Python program that outputs the value of each of the following expressions: 5.0/9.0 5.0/9 5/9.0 5/9 9.0/5.0 9.0/5 9/5.0 9/5 Based on your results, what is the rule for arithmetic operators when integers and floating point numbers are used? 2. Write and run a Python program that asks the user for a temperature in Celsius and converts and outputs the temperature in Fahrenheit. (Use the formula given in the example above and solve for tempFin terms of tempC.) 3. Here is an algorithm to print out n! 4. (n factorial) from 0! to 19!: 1. Set f = 1 2. Set n = 0 3. Repeat the following 20 times: a. Output n, "! = ", f b. Add 1 to n c. Multiply f by n Using a for loop, write and run a Python program for this algorithm.	

5. Modify the program above using a while loop so it prints out all of the factorial values that are less than 1 billion.
6. Modify the first program so it finds the minimum in the array instead of the maximum.
7. (Harder) Modify the first program so that it finds the **index** of the maximum in the array rather than the maximum itself.
8. Modify the bubble sort program so it implements the improvements discussed in class. (HINT: To exit the main loop if the array is already sorted, simply change the loop variable to equal the last value so the loop ends early.)
9. Draw the Target symbol (a set of concentric Squares, alternating red and white) in a graphics window that is 200 pixels wide by 200 pixels high. Hint: Draw the largest circle first in red, then draw the next smaller circle in white, then draw the next smaller circle in red. Graphical objects drawn later appear "on top of" graphical objects drawn earlier.

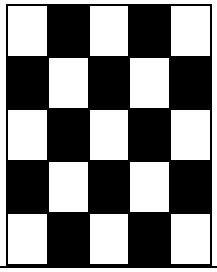


10. Try entering the following literal values at the prompt. (Hit ENTER after each)

    -5
    -4.2
    4.5
    4.14
    0.90

    Something odd should occur. *Describe it on paper.*

11. Reading from a CSV file of the given data using pandas library.
12. For the given data, plot the scatter matrix for males only, and for females only. Do you think that the 2 sub-populations correspond to gender?
13. For the given data, using python environment, apply, 1-sample t-test: testing the value of a population mean.
14. For the given data, using python environment, apply, 2-sample t-test: testing for difference across populations
15. Generate simulated data from python, apply simple linear and multiple linear regression analysis.
16. Retrieve the estimated parameters from the model above. Hint: use tab-completion to find the relevant attribute.
17. Going back to the brain size + IQ data, test if the VIQ of male and female are different after removing the effect of brain size, height and weight.
18. Using matplotlib, visualize the simulated data with suitable statistical measures.
19. Create a 5 X 5 rectangle whose top left corner is at (*row**5, *col**5). (Where is the bottom right corner?) If the sum of the *row* and *col* numbers is even, set

	the fill color of the rectangle to white, otherwise set it to black. Then draw the rectangle. 	
Text Books:	2. Python for Data Science for Dummies - Luca Massaron and John Paul Mueller, John Wiley & Sons, Inc.	
Reference Books:	4. Python for Data Analysis - Wes McKinney, O'Reilly Media, Inc. 5. Data Science from Scratch - Joel Grus, O'Reilly Media, Inc. 6. Python Scripting for Computational Science - Hans Petter Langtangen *** Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference Material:	3. https://www.tutorialspoint.com/python_data_science/index.htm 4. http://dl.booktolearn.com/ebooks2/computer/python/9781498742092_Data_Science_and_Analytics_with_Python_2b29.pdf	

Course Code: IDS406	**Professional Elective Course-I** **Specialization- Data Science** **B.Tech.- Semester-IV** **Exploratory Data Analysis**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On successful completion of the course, students will be able to:-**	
CO1.	Understanding the data and its types for the appropriate exploratory data analysis.	
CO2.	Understanding the importance of Exploratory Data Analysis over summary statistics.	
CO3.	Understanding the importance Univariate statistics in EDA	
CO4.	Applying Univariate statistical graphs for the better representation and interpretation.	
CO5.	Applying the various advanced graphs in Exploratory Data Analysis.	
Course Content:		
Unit-1:	**Introduction to Data and its types** Definition and importance of data, classification of data : based on observation – Cross Sectional, times series and panel data, based on measurement – ratio, interval, ordinal and nominal, based on availability – primary, secondary, tertiary, based on structural form – structured, semi structured and unstructured, based on inherent nature – quantitative and qualitative, concepts on sample data and population, small sample and large sample, statistic and parameter, types of statistics and its application in different business scenarios, frequency distribution of data.	**8Hours**
Unit-2:	**Introduction to Exploratory Data Analysis (EDA)** Definition of EDA, difference between EDA with classical and Bayesian Analysis, comparison of EDA with Classical data summary measures, goals of EDA, Underlying assumptions in EDA, importance of EDA in data exploration techniques, introduction to different techniques to test the assumptions involved in EDA, role of graphics in data exploration, introduction to unidimensional, bidimensional and multidimensional graphical representation of data	**8hours**
Unit-3:	**Data Preparation** Introduction to data exploration process for data preparation, data discovery, issues related with data access, characterization of data, consistency and pollution of data, duplicate or redundant variables, outliers and leverage data, noisy data, missing values, imputation of missing and empty places, with different techniques, missing pattern and its importance, handling non numerical data in missing places.	**8 Hours**

Unit-4:	**Univariate Data Analysis** Description and summary of data set, measure of central tendency – mean: Arithmetic, geometric and harmonic mean – Raw and grouped data, confidence limit of mean, median, mode, quartile and percentile, interpretation of quartile and percentile values, measure of dispersion, concepts on error, range, variance, standard deviation, confidence limit of variance and standard deviation, coefficient of variation, mean absolute deviation, mean deviation, quartile deviation, interquartile range, concepts on symmetry of data, skewness and kurtosis, robustness of parameters, measures of concentration	**8 Hours**
Unit-5:	**Bivariate Data Analysis** Introduction to bivariate distributions, association between two nominal variables, contingency tables, Chi-Square calculations, Phi Coefficient, scatter plot and its causal interpretations, correlation coefficient, regression coefficient, relationship between two ordinal variables – Spearman Rank correlation, Kendall's Tau Coefficients, measuring association between mixed combination of numerical, ordinal and nominal variables	**8Hours**
Text Books:	1. Exploratory Data Analysis – John W Tukey, Addison Wesley Publishing Company	
Reference Books:	1. Graphical Exploratory Data Analysis - S.H.C. du Toit A.G.W. Steyn R.H. Stumpf, Springer Publication 2. Hand book of Data Visualization – Chun-houh Chen, Wolfgang Härdle, Antony Unwin, Springer Publication. 3. Exploratory Data Analysis in Business and Economics - An Introduction Using SPSS, Stata and Excel – Thomas Cleff, Springer Publication.	
Additional Electronic Reference Material:	1. http://www.stat.cmu.edu/~hseltman/309/Book/chapter4.pdf 2. https://www.itl.nist.gov/div898/handbook/toolaids/pff/eda.pdf	

Course Code: **IDS407**	**Professional Elective Course-I** **Specialization- Data Science** **B.Tech.- Semester-IV** **Sampling Techniques**	**L-3** **T-0** **P-0** **C-3**
Course Outcomes:	**On successful completion of the course, students will be able to:-**	
CO1.	Understanding the important terminologies and need for sampling over complete enumeration.	
CO2.	Understanding the need for learning and sampling proportion in sampling theory.	
CO3.	Understanding the mean and variance of the samples drawn using simple random sampling with and without replacement.	
CO4.	Understanding the mean and variance of the samples drawn using stratified and systematic random sampling.	
CO5.	Analyzing different type of sampling techniques.	
Course Content:		
Unit-1:	**Introduction to Sampling:** Introduction, important terminologies related with sampling methods: samples, population, standard error, sampling distribution, sample size, need for sampling, advantages and disadvantages of sampling, important principle steps in sample survey, sample survey vs complete enumeration, the role of sampling theory, probability sampling, alternative to probability sampling, importance of normal distribution in sampling theory, bias and its effects in sampling process, role of mean square error in sampling theory.	**8Hours**
Unit-2:	**Sampling proportions and Percentages:** Introduction, Qualitative characteristics of samples, variances of the sample estimates, the effect of P on the standard errors, probability distribution function: the binomial probability distribution, the hypergeometric distribution, confidence limits, classification into more than two classes, confidence limits with more than two classes, the conditional distribution of p, proportions and totals over subpopulation, comparison between different domains.	**8hours**
Unit-3:	**Simple Random Sampling:** Introduction, need for simple random sampling, overview and definition of simple random sampling with and without replacement, selection of a simple random sample, definitions and notations conventions in simple random sampling, properties of the estimates, variances of the estimates, the finite population correction, estimation of standard error from the samples, confidence limits, estimation of a ratio, estimates of means over subpopulation, estimates of totals over sub population, comparison between domain means, validity of normal approximation, linear estimates of the population mean.	**8 Hours**

Unit-4:	**Stratified and Systemic Random Sampling:** Definition and overview of stratified and systemic random sampling, properties of the estimates, estimated variance and confidence limits, proportional allocation, optimum allocation, Neyman Allocation, relative precision of stratified sampling over simple random sampling, allocation requires more than 100 percent sampling, , Choice of Sample Sizes in Different Strata, advantages and disadvantages of stratified sampling, Systematic Sampling: The Sample Mean and its Variance, Comparison of Systematic with Random Sampling, Comparison of Systematic with Stratified Random Sampling, Estimation of the Variance, two stage sample with equal and unequal units.	**8 Hours**
Unit-5:	**Cluster Sampling:** Equal Clusters: Introduction, definition, efficiency of cluster sampling, Efficiency of Cluster Sampling in Terms of Intra-Class Correlation, Estimation from the Sample of the Efficiency of Cluster Sampling, Relationship between the Variance of the Mean of a Single Cluster and its Size, Optimum Unit of Sampling and Multipurpose Surveys, Unequal Clusters: Estimates of the Mean and their Variances, Probability Proportional to Cluster Size: Estimate of the Mean and its Variance, Probability Proportional to Cluster Size: Efficiency of Cluster Sampling, Probability Proportional to Cluster Size: Relative Efficiency of Different Estimates.	**8Hours**
Text Books:	1. Sampling Theory of Survey with Applications – Pandurang V Sukhatme, Indian society of Agricultural Statistics, New Delhi.	
Reference Books:	1. Large Sample Techniques - Jiming Jiang, Springer. 2. Sampling Methods: Exercises and Solutions - Pascal Ardilly Yves Tillé, Springer. 3. Sampling Techniques, Third Edition - William G. Cochran, Wiley Publications.	
Additional Electronic Reference Material:	1. https://uca.edu/psychology/files/2013/08/Ch7-Sampling-Techniques.pdf 2. http://iced.cag.gov.in/wp-content/uploads/C-07/SAMPLING_TECHNIQUES.pdf	

Course Code: **IDS408**	**Professional Elective Course-I** **Specialization- Data Science** **B.Tech.- Semester-IV** **Data Aggregation and Pre-processing**	**L-3** **T-0** **P-0** **C-3**
Course Outcomes:	**On successful completion of the course, students will be able to:-**	
CO1.	Understanding the importance of data pre-processing for Data Analysis.	
CO2.	Understanding the concepts of graphical representation of Univariate, bivariate and multivariate data.	
CO3.	Applying data pre-processing techniques as part of data analysis.	
CO4.	Applying the suitable data aggregation function in appropriate situations.	
CO5.	Analyzing the missing value techniques and impute them using suitable techniques.	
Course Content:		
Unit-1:	**Data Loading, Storage, and File Formats** ▪ Reading and Writing Data in Text Format ▪ Binary Data Formats ▪ Interacting with Web APIs ▪ Interacting with Databases	**8Hours**
Unit-2:	**Data Cleaning and Preparation** ▪ Handling Missing Data ➢ Filtering Out Missing Data ➢ Filling in Missing Data ▪ Data Transformation ➢ Removing Duplicates ➢ Replacing Values ➢ Renaming Axis Indexes ➢ Discretization and Binning ➢ Detecting and Filtering Outliers ➢ Permutation and Random Sampling ➢ Computing Indicator/Dummy Variables ➢ String Manipulation	**8hours**
Unit-3:	**Data Wrangling: Join, Combine, and Reshape** ▪ Hierarchical Indexing. ➢ Reordering and Sorting Levels	**8 Hours**

	➢ Summary Statistics by Level ➢ Indexing with a Data Frame's columns ▪ Combining and Merging Datasets ➢ Database-Style DataFrame Joins ➢ Merging on Index ➢ Concatenating Along an Axis ➢ Reshaping and Pivoting	
Unit-4:	**Data Aggregation and Group Operations** ▪ GroupBy Mechanics ▪ Data Aggregation ▪ Apply: General split-apply-combine ▪ Pivot Tables and Cross-Tabulation	**8 Hours**
Unit-5:	**Plotting and Visualization** ▪ matplotlib API Primer ▪ Plotting with pandas and seaborn ▪ Other Python Visualization Tools	**8Hours**
Text Books:	1. Python for Data Analysis Data Wrangling with Pandas, NumPy, and IPython, Second Edition - Wes McKinney, O'Reilly	
Reference Books:	1. Exploratory Data Analysis in Business and Economics - An Introduction Using SPSS, Stata and Excel – Thomas Cleff, Springer Publication. 2. Graphical Exploratory Data Analysis - S.H.C. du Toit A.G.W. Steyn R.H. Stumpf, Springer Publication. 3. Principles of Data Wrangling Practical Techniques for Data Preparation, First Edition - Tye Rattenbury, Joseph M. Hellerstein, Jeffrey Heer, Sean Kandel, and Connor Carreras, O'Reilly.	
Additional Electronic Reference Material:	4. http://hanj.cs.illinois.edu/cs412/bk3/03.pdf 5. http://www.itu.dk/~tped/teaching/pervasive/SPCT-F2015/L12-13/11_DataPr_chapter2_data-mining.pdf	

Course Code: **TMUGA-401**	**Specialization- Data Science** **BTech- Semester-IV** **Analytical Reasoning** **(Value Added Course)**	**L-2** **T-1** **P-0** **C-0**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Applying the arithmetical concepts in Ratio Proportion Variation.	
CO2.	Employing the techniques of Percentage; Ratios and Average in inter related concepts of Time and Work, Time Speed and Distance.	
CO3.	Identifying different possibilities of reasoning based problems of Syllogisms and Venn diagram.	
CO4.	Examining the optimized approach to solve logs and Surds.	
Course Content:		
Unit-1:	**Ratio, proportions and variations** Concept of ratios, proportions, variations, properties and their applications	**5 Hours**
Unit-2:	**Time and Work** Same efficiency, different efficiency, alternate work, application in Pipes and Cisterns	**6 Hours**
Unit-3:	**Time Speed Distance** Average speed, proportionalities in Time, Distance, trains, boats, races, circular tracks	**6 Hours**
Unit-4:	**Logs and Surds** Concept and properties of logs, surds and indices	**4 Hours**
Unit-5:	**Coding and decoding** Sequential coding, reverse coding, abstract coding	**3 Hours**
Unit-6:	**Syllogisms** Two statements, three statements	**4 Hours**
Unit-7:	**Venn diagram** Basic concept and applications	**2 Hours**
Reference Books:	• R1:-Arun Shrama:- How to Prepare for Quantitative Aptitude • R2:-Quantitative Aptitude by R.S. Agrawal • R3:-M Tyra: Quicker Maths • R4:-Nishith K Sinha:- Quantitative Aptitude for CAT • R5:-Reference website:- Lofoya.com, gmatclub.com, cracku.in, handakafunda.com, tathagat.mba, Indiabix.com • R6:-Logical Reasoning by Nishith K Sinha • R7:-Verbal and Non Verbal Reasoning by R.S. Agrawal *** Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference Material:	• https://www.indiabix.com/logical-reasoning/questions-and-answers/ • https://www.freshersnow.com/reasoning-questions-answers/	

Course Code: **IDS501**	**Specialization- Data Science** **B. Tech- Semester-V** **Data Mining Techniques**	**L-3** **T-0** **P-0** **C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the difference between CRISP –DM and KDD process of data mining.	
CO2.	Understanding the data pre-processing technique for the data mining.	
CO3.	Understanding the different data classification techniques and its practical use in data mining project.	
CO4.	Understanding the basic concepts of text mining and able to cluster the text using statistical programming language.	
CO5.	Applying association rule mining for the appropriate data set and conclude the results for decision making process.	
Course Content:		
Unit-1:	**Introduction to Data Mining:** Data mining, evolution of data mining, definition and concepts, introduction to data mining process, data mining methodology, over view of CRISP-DM and KDD process, over view of data mining algorithms, organization of data, Univariate and multivariate data distributions, distance measures and similarity measures, attribute selection, data cleaning and integrity, data split, test data, training data, validation data, mistakes in data mining, myths about data mining.	**8 Hours**
Unit-2:	**Data Preparation:** Introduction, feature extraction and portability, data type portability, discretization and binarization, text to numeric data, Time Series to Discrete Sequence Data, Time Series to Numeric Data, Discrete Sequence to Numeric Data, Data Cleaning: Handling Missing Entries, Handling Incorrect and Inconsistent Entries, Scaling and Normalization, Data Reduction and Transformation, Dimensionality Reduction with Axis Rotation, Dimensionality Reduction with Type Transformation.	**8 Hours**
Unit-3:	**Association Pattern Mining:** Introduction, The Frequent Pattern Mining Model, Association Rule Generation Framework, Frequent Itemset Mining Algorithms: Brute Force Algorithms, Apriori Algorithms, Enumeration-Tree Algorithms, Enumeration-Tree-Based Interpretation of Apriori, Tree Projection and Depth Project, Vertical Counting Methods, Recursive Suffix-Based Pattern Growth Methods, Alternative Models: Interesting Patterns, Statistical Coefficient of Correlation, Chi Square Measure, Interest Ratio, Symmetric Confidence Measures, Cosine Coefficient on Columns, Jaccard Coefficient and the Min-hash Trick, Collective Strength, Relationship to Negative Pattern Mining, Useful Meta-algorithms.	**8 Hours**
Unit-4:	**Data Classification:** Introduction, feature selection for classification, Filter models: Gini	**8 Hours**

	Index, Entropy, Fisher Score, Fisher Linear Discriminant, Wrapper models and embedded models, Decision Trees: Stopping criteria, Pruning of tree, Rule-Based Classifiers: Rule Generation from Decision Trees, Sequential Covering Algorithms, Rule Pruning, Probabilistic Classifiers: Naïve Bayes Classification and logistic regression, Support vector Machine and Neural Networks.	
Unit-5:	**Text Mining:** Definition of text mining, general architecture of text mining, text mining operations, Text mining query languages, application of text categorization, document representation, machine learning and classifier evaluation, clustering task in text mining and its interpretation, word cloud, customization of word cloud.	**8 Hours**
Text Books:	1. Data Mining The Text Book, Charu C Aggarwal, Springer	
Reference Books:	1. Applied Data Mining Statistical Methods for Business and Industry, PAOLO GIUDICI, John Wiley & Sons Ltd. 2. Data Mining, Ian H. Witten, Eibe Frank, Mark A. Hall, Third Edition, ELSEVIER *** Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference Material:	1. http://myweb.sabanciuniv.edu/rdehkharghani/files/2016/02/The-Morgan-Kaufmann-Series-in-Data-Management-Systems-Jiawei-Han-Micheline-Kamber-Jian-Pei-Data-Mining.-Concepts-and-Techniques-3rd-Edition-Morgan-Kaufmann-2011.pdf 2. https://www.vssut.ac.in/lecture_notes/lecture1422914558.pdf	

Course Code: **IDS502**	**Specialization- Data Science** **B. Tech- Semester-V** **NoSQL Database**	**L-3** **T-0** **P-0** **C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the concepts of NoSQL databases.	
CO2.	Understanding about basic principles and design criteria of NoSQL databases.	
CO3.	Understanding the concepts of different types of NoSQL databases.	
CO4.	Understanding about data storage and processing techniques.	
CO5.	Applying the various queries used in NoSQL databases.	
Course Content:		
Unit-1:	**Introduction to NoSQL:** Understanding NoSQL Databases, History of NoSQL, Features of NoSQL, Scalability, Cost, Flexibility, NoSQL Business Drivers, Classification and Comparison of NoSQL Databases, Consistency – Availability - Partitioning (CAP), Limitations of Relational Databases, Comparing NoSQL with RDBMS Managing Different Data Types, Columnar, Key-Value Stores, Triple and Graph Stores, Document, Search Engines, Hybrid NoSQL Databases, Applying Consistency Methods, ACID, BASE, Polyglot persistence.	**8 Hours**
Unit-2:	**EvaluatingNoSQL:** The Technical Evaluation, Choosing NoSQL, Search Features, Scaling NoSQL, Keeping Data Safe, Visualizing NoSQL, Extending Data Layer, Business Evaluation, Deploying Skills, Deciding Open Source versus commercial software, Business critical features, Security.	**8 Hours**
Unit-3:	**Key-Value & Document Based Databases:** Introduction to Key-Value Databases, Key Value Store, Essential Features, Consistency, Transactions, Partitioning, Scaling, Replicating Data, Versioning Data, How to construct a Key, Using Keys to Locate Values, Hash Functions, Store data in Values, Use Cases. Introduction to Document Databases, Supporting Unstructured Documents, Document Databases Vs. Key-Value Stores, Basic Operation on Document database, Partition, Sharding, Features, Consistency, Transactions, Availability, Scaling, Use Cases.	**8 Hours**
Unit-4:	**Column-Oriented & Graph Based Databases:** Introduction to Column Family Database, Features, Architectures, Differences and Similarities to Key Value and Document Database, Consistency, Transactions, Scaling, Use Cases**.** Introduction to Graph Databases, Advantages, Features, Consistency, Transactions, Availability, Scaling, Graph & Network Modelling, Properties of Graphs and Noes, Types of Graph, Undirected and directed Graph, Flow Network, Bipartite Graph, Multigraph, Weighted Graph.	**8 Hours**

Unit-5:	**Search Engine:** Common Feature of Search Engine, Dissecting a Search Engine, Search versus query, Web crawlers, Indexing, Searching, indexing Data Stores, Altering, Using Reverse queries, Use Cases, Types of Search Engine, Elastic Search.	**8 Hours**
Text Books:	1. NoSQL for Dummies, By: Adam Fowler, Published by: John Wiley & Sons, Inc.	
Reference Books:	1. NoSQL Distilled, By: Pramod J. Sadalage& Martin Fowler, Published by: Pearson Education, Inc. 2. Making Sense of NoSQL, By: Dan McCreary& Ann Kelly, Published by: Manning Shelter Island 3. NoSQL for Mere Mortals, By: Dan Sullivan, Published by: Pearson Education, Inc. *** Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference Material:	1. https://www.javatpoint.com/nosql-databases 2. https://www.christof-strauch.de/nosqldbs.pdf	

Course Code: IDS503	**Specialization- Data Science** **B. Tech- Semester-V** **Software Engineering**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the software engineering lifecycle by demonstrating competence in communication, planning, analysis, design, construction, and deployment.	
CO2.	Understanding the concepts of various software models.	
CO3.	Understanding the concepts of developing quality software.	
CO4.	Applying current theories, models, and techniques that provide a basis for the software lifecycle.	
CO5.	Applying various techniques and tools necessary for engineering practice.	
Course Content:		
Unit-1:	**Software Product and Process:** Introduction – S/W Engineering Paradigm – Verification – Validation – Life Cycle Models – System Engineering – Computer Based System – Business Process Engineering, Overview – Product Engineering Overview.	**8 Hours**
Unit-2:	**Software Requirements:** Functional and Non-Functional – Software Document – Requirement Engineering Process – Feasibility Studies – Software Prototyping – Prototyping in the Software Process – Data – Functional and Behavioural Models – Structured Analysis and Data Dictionary.	**8 Hours**
Unit-3:	**Analysis, Design Concepts and Principles:** Systems Engineering - Analysis Concepts - Design Process And Concepts – Modular Design – Design Heuristic – Architectural Design – Data Design – User Interface Design – Real Time Software Design – System Design – Real Time Executives – Data Acquisition System – Monitoring And Control System.	**8 Hours**
Unit-4:	**Testing:** Taxonomy Of Software Testing – Types Of S/W Test – Black Box Testing – Testing Boundary Conditions – Structural Testing – Test Coverage Criteria Based On Data Flow Mechanisms – Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing And Debugging – Software Implementation Techniques.	**8 Hours**
Unit-5:	**Software Project Management:** Measures And Measurements – ZIPF's Law – Software Cost Estimation – Function Point Models – COCOMO Model – Delphi Method – Scheduling – Earned Value	**8 Hours**

	Analysis – Error Tracking – Software Configuration Management – Program Evolution Dynamics – Software Maintenance – Project Planning – Project Scheduling– Risk Management – CASE Tools	
Text Books:	1. Roger S. Pressman, "Software Engineering – A practitioner's Approach", Sixth Edition, McGraw-Hill International Edition, 2005	
Reference Books:	1.Software Architecture in Practice (3rd Edition) by Len Bass (Author), Paul Clements (Author), Rick Kazman (Author) 2. Software Engineering: The Current Practice by Vaclav Rajlich (Author) 3. Ian Sommerville, "Software engineering", Seventh Edition, Pearson Education Asia, 2007 *** Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference Material:	1. https://www.vssut.ac.in/lecture_notes/lecture1428551142.pdf 2. http://www.crectirupati.com/sites/default/files/lecture_notes/SE%20FINAL%20NOTES%20BY%20MUKESH.D.pdf	

Course Code: **IDS504**	**Specialization- Data Science** **B. Tech- Semester-V** **Computer Networks**	**L-3** **T-0** **P-0** **C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the concepts of Network fundamentals.	
CO2.	Understanding the basics of Network Devices and their uses.	
CO3.	Understanding the concepts of various Network Layers and its importance.	
CO4.	Understanding the various Network Technologies and Topologies.	
CO5.	Understanding Network Operating Systems and Troubleshooting Network.	
Course Content:		
Unit-1:	Basics of Network & Networking, Advantages of Networking, Types of Networks, Network Terms- Host, Workstations, Server, Client, Node, Types of Network Architecture- Peer-to-Peer & Client/Server, Workgroup Vs. Domain. Network Topologies, Types of Topologies, Logical and physical topologies, selecting the Right Topology, Types of Transmission Media, Communication Modes, Wiring Standards and Cabling- straight through cable, crossover cable, rollover cable, media connectors (Fiber optic, Coaxial, and TP etc.) Introduction of OSI model, Seven layers of OSI model, Functions of the seven layers, Introduction of TCP/IP Model, TCP, UDP, IP, ICMP, ARP/RARP, Comparison between OSI model & TCP/IP model. Overview of Ethernet Addresses.	**8 Hours**
Unit-2:	**Basics of Network Devices:** Network Devices- NIC- functions of NIC, installing NIC, Hub, Switch, Bridge, Router, Gateways, And Other Networking Devices, Repeater, CSU/DSU, and modem, Data Link Layer: Ethernet, Ethernet standards, Ethernet Components,Point-to-Point Protocol(PPP),PPP standards, Address Resolution Protocol, Message format, transactions, Wireless Networking: Wireless Technology, Benefits of Wireless Technology, Types of Wireless Networks: Ad-hoc mode, Infrastructure mode, Wireless network Components: Wireless Access Points, Wireless NICs, wireless LAN standards: IEEE 802.11a, IEEE 802.11b, IEEE 802.11g, wireless LAN modulation techniques, wireless security Protocols: WEP,WPA, 802.1X, Installing a wireless LAN	**8 Hours**
Unit-3:	**Basics of Network, Transport and Application Layers:** Network Layer: Internet Protocol (IP), IP standards, versions, functions, IPv4 addressing, IPv4 address Classes, IPv4 address types, Subnet Mask, Default Gateway, Public & Private IP Address, methods of assigning IP address, IPv6 address, types, assignment, Data encapsulation, The IPv4 Datagram Format, The IPv6 Datagram Format, Internet Control Message Protocol (ICMP), ICMPv4, ICMPv6, Internet Group Management Protocol (IGMP),Introduction to Routing and Switching concepts, Transport Layer: Transmission Control Protocol(TCP), User Datagram Protocol (UDP), Overview of Ports & Sockets, Application Layer: DHCP, DNS, HTTP/HTTPS, FTP, TFTP, SFTP, Telnet, Email: SMTP, POP3/IMAP, NTP.	**8 Hours**

Unit-4:	**WAN Technology:** What Is a WAN?, WAN Switching, WAN Switching techniques Circuit Switching, Packet Switching etc., Connecting to the Internet : PSTN, ISDN, DSL, CATV, Satellite-Based Services, Last Mile Fiber, Cellular Technologies, Connecting LANs : Leased Lines, SONET/SDH, Packet Switching,Remote Access: Dial-up Remote Access, Virtual Private Networking, SSL VPN, Remote Terminal Emulation, Network security: Authentication and Authorization, Tunneling and Encryption Protocols, IPSec, SSL and TLS,Firewall, Other Security Appliances, Security Threats	**8 Hours**
Unit-5:	**Network Operating Systems and Troubleshooting Network:** Network Operating Systems: Microsoft Operating Systems, Novell NetWare, UNIX and Linux Operating Systems, Macintosh Networking, Trouble Shooting Networks: Command-Line interface Tools, Network and Internet Troubleshooting, Basic Network Troubleshooting : Troubleshooting Model, identify the affected area, probable cause, implement a solution, test the result, recognize the potential effects of the solution, document the solution, Using Network Utilities: ping, traceroute, tracert, ipconfig, arp, nslookup, netstat, nbtstat, Hardware trouble shooting tools, system monitoring tools.	**8 Hours**
Text Books:	1. CCNA Cisco Certified Network Associate: Study Guide 7th Edition (Paperback), Wiley India, 2011	
Reference Books:	1. Routing Protocols and Concepts CCNA Exploration Companion Guide (With CD) (Paperback), Pearson, 2008 2. CCNA Exploration Course Booklet: Routing Protocols and Concepts, Version 4.0 (Paperback), Pearson, 2010. 3. CCENT/CCNA ICND1 640-822 Official Cert Guide 3 Edition (Paperback), Pearson, 2013. *** Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference Material:	1. https://www.cse.iitk.ac.in/users/dheeraj/cs425/ 2. http://intronetworks.cs.luc.edu/current2/ComputerNetworks.pdf	

Course Code: **IDS505**	**Specialization- Data Science** **B. Tech- Semester-V** **Theory of Computation**	**L-3** **T-0** **P-0** **C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the mathematical models for representing finite state systems.	
CO2.	Understanding the various applications of regular expressions and the properties of regular languages.	
CO3.	Understanding the concepts of PDA.	
CO4.	Applying the parse trees and analyze the ambiguity of grammar.	
CO5.	Applying the various grammars to design computational machine.	
Course Content:		
Unit-1:	**Finite Automata and Regular Expressions:** Introduction of Unit, Deterministic and Non-Deterministic Finite Automata, Finite Automata with ε-moves, regular expressions – equivalence of NFA and DFA, Two-way finite automata, Moore and Mealy machines, Applications of finite automata, Conclusion and Summary of Unit.	**8 Hours**
Unit-2:	**Regular sets and context free grammars:** Introduction of Unit, Properties of regular sets, context-Free, Grammars – derivation trees , Chomsky Normal Forms and Greibach Normal Forms, Ambiguous and unambiguous grammars , Minimization of finite automata, Conclusion and Summary of Unit.	**8 Hours**
Unit-3:	**Pushdown automata and Parsing Algorithms:** Introduction of Unit, Pushdown Automata and context-free languages, Top-down parsing and Bottom-up parsing, Properties of CFL, Applications of pumping lemma, closure properties of CFL and decision algorithms, Conclusion and Summary of Unit.	**8 Hours**
Unit-4:	**Turing machines:** Introduction of Unit, Turing machines(TM), computable languages and functions, tuning machine constructions, storage in finite control, variations of TMs, recursive and recursive enumerable languages, Conclusion and Summary of Unit.	**8 Hours**
Unit-5:	**Introduction to Computational Complexity :** Introduction of Unit, Time and Space complexity of TMs , A non recursive	**8 Hours**

	language and unsolvable Decision problems, Reducing one problem to another, The halting problem, Rice's Theorem , Closure Properties of families of languages, Conclusion and Summary of Unit.	
Text Books:	1. Martin, "Introduction to Languages & Theory of Computation", TMH.	
Reference Books:	1. Martin, "Introduction to Languages & Theory of Computation", TMH. 2. V Raghvan, " Principles of Compiler Design", TMH 3. Hopcroft and Ullman, "Introduction to Automata Theory Languages and Computation",Addison Wesley. *** Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference Material:	1. https://www.cis.upenn.edu/~cis262/notes/tcbook-u.pdf 2. http://www.vssut.ac.in/lecture_notes/lecture1428551440.pdf	

Course Code: EHM501	**Specialization- Data Science** **B. Tech- Semester-V** **HUMAN VALUES & PROFESSIONAL ETHICS**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the importance of value education in life and method of self-exploration.	
CO2.	Understanding 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration.	
CO3.	Applying right understanding about relationship and physical facilities.	
CO4.	Analysing harmony in myself, harmony in the family and society, harmony in the nature and existence.	
CO5.	Evaluating human conduct on ethical basis.	
Course Content:		
Unit-1:	Understanding of Morals, Values and Ethics; Introduction to Value Education- need for Value Education. Self- Exploration–content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration. Continuous Happiness and Prosperity- basic Human Aspirations. Gender Issues: Gender Discrimination and Gender Bias (home & office), Gender issues in human values, morality and ethics.	**8 Hours**
Unit-2:	Conflicts of Interest: Conflicts between Business Demands and Professional Ethics. Social and Ethical Responsibilities of Technologists. Ethical Issues at Workplace: Discrimination, Cybercrime, Plagiarism, Sexual Misconduct, Fraudulent Use of Institutional Resources. Intellectual Property Rights and its uses. Whistle blowing and beyond, Case study.	**8 Hours**
Unit-3:	Harmony in the Family and Society- Harmony in Human-Human Relationship, Understanding harmony in the Family- the basic unit of human interaction. Understanding values in human-human relationship; meaning of Nyaya; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship. Understanding the meaning of Vishwas; Difference between intention and competence. Understanding the meaning of Samman and other salient values in relationship.	**8 Hours**
Unit-4:	Understanding Harmony in the Nature and Existence – Whole existence as Co-existence. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature. Understanding Existence as Coexistence (Sah-astitva) of mutually interacting units in all pervasive space. Holistic perception of harmony at all levels of existence.	**8 Hours**

Unit-5:	Implications of the above Holistic Understanding of Harmony on Professional Ethics. Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Competence in professional ethics: a) Ability to utilize the professional competence for augmenting universal human order b) Ability to identify the scope and characteristics of people friendly and eco-friendly production systems c) Ability to identify and develop appropriate technologies and management patterns for above production systems.	**8 Hours**
Text Books:	1. R R Gaur, R Sangal, G P Bagaria, A Foundation Course in Value Education.	
Reference Books:	1. Ivan Illich, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA 2. E.F. Schumacher, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain. 2. A Nagraj, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak. 3. Sussan George, How the Other Half Dies, Penguin Press. Reprinted. 4. PL Dhar, RR Gaur, Science and Humanism, Commonwealth Purblishers. *** Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference Material:	1. http://crectirupati.com/sites/default/files/lecture_notes/HVPE-MBA-K%20YAMUNA-LECTURE%20NOTES.pdf 2. https://soaneemrana.org/onewebmedia/Professional%20Ethics%20and%20Human%20Values%20by%20R.S%20NAAGARAZAN.pdf	

Course Code: **IDS551**	**Specialization- Data Science** **B.Tech- Semester-V** **Data Mining Techniques(LAB)**	**L-0** **T-0** **P-4** **C-2**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the concepts of designing a data mart or data warehouse for any organization.	
CO2.	Understanding about various data mining tools.	
CO3.	Applying data mining techniques and methods to large data sets.	
CO4.	Applying the various classifiers used in data mining.	
CO5.	Creating a program using weka to perform operation on given data sets.	
Course Content:		
List of Experiments	**1.** Build Data warehouse/Data Mart (using open source tools like pentaho Data Integration Tool, Pentaho Business Analytics; or other data warehouse tools. i. Identify source tables and populate sample data. The data warehouse contains 4 tables: 1. Data dimension: contains every single data from 2006 to 2016. 2. Customer dimension: contains 100 customers. To be simple we'll make it type 1 so we don't create a new row for each change. 3. Van dimension: contains 20 vans. To be simple we'll make it type 1 so we don't create a new row for each change. 4. Hire fact table: contains 1000 hire transactions since 1st Jan 2011. It is a daily snapshot fact table so that every day we insert 1000 rows into this fact table. So over time we can track the change of total bill, van charges, satnav income, etc. 2. A jar has 1000 coins, of which 999 are fair and 1 is double headed. Pick a coin at random, and toss it 10 times. Given that you see 10 heads, what is the probability that the next toss of that coin is also a head? 3. Write a program by creating a data set (weather or Employee table) using Weka and perform the following practicals. i) Apply pre-processing techniques to above data set. ii) Normalize the above data set iii) Demonstrate performing association rule mining on above data set.	

	iv) Construct Decision tree for the above data set and classify it. v) Demonstrate preforming regression on above data set. vi) Demonstrate performing classification on above data set. vii) Demonstrate performing clustering on above data set. viii) Write a procedure for visualization on above data set. 4. Write a program to show a few major challenges of mining a huge amount of data in comparison with mining a small amount of data.(e.g., data set of a few hundred tuple)? 5. Write a program by taking a group of 12 sales price records has been sorted as follows: 5,10,11,13,15,35,50,55,72,92,204,215 Partition them into three bins by each of the following methods: i) Equal-width partitioning ii) Clustering. iii) Equal-frequency (equal-depth) partitioning 6. Work on the following statements after creating a database with columns like age and percentage of fat readings. i) Normalize the two attributes based on z-score normalization. ii) Calculate the correlation coefficient (Pearson's Product moment coefficient). Are these two attributes positively or negatively correlated? Compute their covariance. 7. Write a program to compute a data cube where the condition is that the minimum number of records is 10 and the average fare is over $500. Outline an efficient cube computation method (based on common sense about flight data distribution). 8. Design data warehouse for student attendance analysis.	

Course Code: **IDS552**	**Specialization- Data Science** **B. Tech- Semester-V** **NoSQL Database Lab**	**L-0** **T-0** **P-4** **C-2**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding about NoSQL databases.	
CO2.	Understanding about basic principles and design criteria of NoSQL databases.	
CO3.	Applying various queries used in NoSQL databases.	
CO4.	Analyzing various data storage and processing techniques.	
CO5.	Creating NoSQL databases to perform various operations.	
Course Content:		
Experiment 1:	Prepare and install infrastructure for setting up MongoDB lab. •Install MongoDB Community Edition ✓ Download MongoDB Community Edition ✓ Run the MongoDB installer ✓ Follow the MongoDB Community Edition installation wizard •Run MongoDB Community Edition as a Windows Service •Run MongoDB Community Edition from the Command Interpreter It is advised to follow below URL: https://docs.mongodb.com/manual/tutorial/install-mongodb-on-windows/	**6 Hours**
Experiment 2:	Perform / execute below sets of basic commands on MongoDB lab environment. • Login to Lab • Show all Databases • Select database to work with • Authenticate and Log out from databases • List down Collections, Users, Roles • Create Collection	**6 Hours**
Experiment 3:	Perform / execute below sets of basic commands on MongoDB lab environment. • Insert Document • Save Document • Update Document • Display Collection Records • Drop Function	**6 Hours**
Experiment 4:	Perform / execute below sets of advanced commands on MongoDB lab environment. • Administrative Commands • Projection • Limit Method • Skip Method	**6 Hours**

	• Sort Records • Indexing • Aggregation • Interacting with cursors	
Experiment 5:	Execute below steps by inserting some data which we can work with. Paste the following into your terminal to create a petshop with some pets in it use petshop db.pets.insert({name: "Mikey", species: "Gerbil"}) db.pets.insert({name: "Davey Bungooligan", species: "Piranha"}) db.pets.insert({name: "Suzy B", species: "Cat"}) db.pets.insert({name: "Mikey", species: "Hotdog"}) db.pets.insert({name: "Terrence", species: "Sausagedog"}) db.pets.insert({name: "Philomena Jones", species: "Cat"}) • Add another piranha, and a naked mole rat called Henry. • Use find to list all the pets. Find the ID of Mikey the Gerbil. • Use find to find Mikey by id. • Use find to find all the gerbils. • Find all the creatures named Mikey. • Find all the creatures named Mikey who are gerbils. • Find all the creatures with the string "dog" in their species.	**6 Hours**
Experiment 6:	AirPhone Corp is a famous telecom company. They have customers in all locations. Customers use AirPhone Corp's network to make calls. Government has brought in a regulation that all telecom companies should store call details of their customers. This is very important from a security point of view and all telecom companies have to retain this data for 15 years. AirPhone Corp already stores all customer details data, for their analytics team. But due to a surge in mobile users in recent years, their current database cannot handle huge amounts of data. Current database stores only six months of data. AirPhone Corp now wants to scale their database and wants to store 15 years of data. Data contains following columns: Source : Phone number of caller Destination : Phone number of call receiver Source_location : Caller's city Destination_location : Call receiver's city Call_duration : phone call duration Roaming : Flag to check if caller is in roaming Call_charge : Money charged for call Sample Data: { source: "+919612345670", destination: "+919612345671", source_location: "Delhi", destination_location: "Mumbai",	

	call_duration: 2.03, roaming: false, call_charge: 2.03 } After discussing the requirements with database and architecture team, it has been decided that they should use MongoDb. You have been given the task to Setup a distributed system (database) such that data from different locations go to different nodes (to distribute the load) • Import data to sharded collection • Check data on each shard for distribution	
Experiment 7:	Execute below sets of problem by taking reference of Experiment Number 06 and find out: • Add additional node to existing system (to test if we can add nodes easily when data increases) • Check the behavior of cluster (data movement) on adding a shard. • Check the behavior of query for finding a document with source location Mumbai.	
Experiment 8:	Anand Corp is a leading corporate training provider. A lot of prestigious organizations send their employees to Anand Corp for training on different skills. As a distinct training provider, Anand Corp has decided to share analysis report with their clients. This report will help their clients know the employees who have completed training and evaluation exam, what are their strengths, and what are the areas where employees need improvement. This is going to be a unique selling feature for the Anand Corp. As Anand Corp is already doing great business and they give training to a large number of people every month, they have huge amount of data to deal with. They have hired you as an expert and want your help to solve this problem. **Attributes of data**: Id : id of the person who was trained Name : name of the person who was trained Evaluation : evaluation term Score : score achieved by the person for the specific term A person can undergo multiple evaluations. Each evaluation will have a unique result score. You can see the sample data below. Sample Data { "_id":0, "name":"Andy", "results": [{"evaluation":"term1","score":1.463179736705023}, {"evaluation":"term2","score":11.78273309957772}, {"evaluation":"term3","score":6.676176060654615}	

	] } PQR Corp has assigned the following tasks to you to analyze the results: Find count and percentage of employees who failed in term 1, the passing score being 37.	
Experiment 9:	Execute below sets of problem by taking reference of Experiment Number 08 and find out: • Find employees who failed in aggregate (term1 + term2 + term3). • Find the Average score of trainees for term1.	
Experiment 10:	Execute below sets of problem by taking reference of Experiment Number 08 and find out: • Find the Average score of trainees for aggregate (term1 + term2 + term3). • Find number of employees who failed in all the three (term1 + term2 + term3). • Find the number of employees who failed in any of the three (term1 + term2 + term3).	
Experiment 11:	Case study on 5 different IT Companies who are working on Mongo DB. Explain on the below parameters: • Why moved to NoSQL • Advantages over NOSQL • Business Benefits • Technology Adaptation	

Course Code: **IDS553**	**Specialization- Data Science** **B.Tech.- Semester-V** **Industrial Training Seminar**	**L-0** **T-0** **P-2** **C-1**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the past and present of the disciplines by exploring their purpose, practice, and philosophy.	
CO2.	Understanding of advanced research methodologies in the field, including theory, interdisciplinary approaches, and the analysis of available primary sources.	
CO3.	Understanding historical and recent trends in theory and method and be able to identify and explain major trends and issues in industry and research.	
C04	Understanding the privileges and obligations associated with a career as a professional	
C05	Demonstrating through short written assignments and critical reviews the ability to synthesize and assess the arguments of scholarly articles and monographs at the level of professionals in the field.	
Course Content:		
	Students will have to undergo industrial training of minimum four weeks in any industry or reputed organization after the IV semester examination in summer. The evaluation of this training shall be included in the V semester evaluation. The student will be assigned a faculty guide who would be the supervisor of the student. The faculty would be identified before the end of the IV semester and shall be the nodal officer for coordination of the training. Students will prepare an exhaustive technical report of the training during the V semester which will be duly signed by the officer under whom training was undertaken in the industry/ organization. The covering format shall be signed by the concerned office in-charge of the training in the industry. The officer-in-charge of the trainee would also give his rating of the student in the standard University format in a sealed envelope to the Principal of the college. The student at the end of the V semester will present his report about the training before a committee constituted by the Director of the College which would comprise of at least three members comprising of the Department Coordinator, Class Coordinator and a nominee of the Director. The students guide would be a special invitee to the presentation. The seminar session shall be an open house session. The internal marks would be the average of the marks given by each member of the committee separately in a sealed envelope to the Director. The marks by the external examiner would be based on the report submitted by the student which shall be evaluated by the external examiner and cross examination done of the student concerned. Not more than three students would form a group for such industrial training/ project submission. **The marking shall be as follows.** Internal: 50 Marks By the faculty guide - 25 marks By committee appointed by the director – 25 marks External: 50 Marks By officer-in-charge trainee in industry – 25 marks By external examiner appointed by the university – 25 marks	

Course Code: IDS506	**Professional Elective Course-II** **Specialization- Data Science** **B.Tech.- Semester-V** **Data Analytics using SQL**	**L-3 T-0 P-2 C-4**
Course Outcomes:	**On successful completion of the course, students will be:-**	
CO1.	Understanding the concept of SQL.	
CO2.	Understanding the different conditional statement for Aggregating and grouping data.	
CO3.	Understanding the application and importance of multi table join operation.	
CO4.	Applying the different methods to extract data from different tables in a database.	
CO5.	Creating the database, tables and manipulate the data in table.	
Course Content:		
Unit-1:	**Introduction to SQL** Introduction to Structure Query Language (SQL), SQL History & Evolution, Features of SQL, Understanding of SQL process, Benefits and Role of SQL along with different market forces, Types of SQL, SQL Standards, SQL and Networking, Centralized architecture, File Server Architecture, Client Server Architecture, Multitier Architecture, Understanding concept for OLAP and OLTP Applications, Difference between OLAP and OLTP, SQL and Database Management, Data warehouse Concept	**8 Hours**
Unit-2:	**SQL Statements & Executions** Types of SQL Statement, Data Definition language, Data Control language, Data Manipulation Language, Types of execution, Direct Invocation, Embedded SQL, Module Binding, Call-level interface, Data types, Constants, Numeric Constants, String Constants, Time & date Constants, Symbolic Constants, Expressions, Built in function, Null Values, Primary and Foreign Key Concept	**8 hours**
Unit-3:	**Starting with basic SQL Syntax** Types of Tables, Create Database statement, Drop database Statement, Use statement, Create table Statement, Drop table Statement, Create index Statement, Drop index Statement, Describe Statement, Truncate Statement, Alter table Statement, Insert INTO Statement, Update table Statement, Delete table Statement, Commit Statement. Create SQL Tables, Specify Column data types, Create user Defined Types, Specify Column Default Values, Alter SQL Tables, Updating Data, Using WHERE	**8 Hours**

	Clause, Using Logical operations, AND operations, OR operations, Deleting SQL table	
Unit-4:	**Extracting Information & Manipulating Data** Select Statement, Returning only Distinct Rows, Using Aliases, Filtering Results using WHERE Clause, Logical Operations and Operator Precedence, NOT operator, BETWEEN Operator, LIKE Operator, IN Operator, Ordering Results with ORDER BY Understanding SQL Arithmetic, basic Math operations, ABS() function, POWER() function, SQRT() function, RAND() function, CEILING() function, FLOOR() function, ROUND() function, SUBSTRING() function, Case Conversion Functions, REVERSE() function, TRIM() function, LENGTH() function, SOUNDEX() function, DIFFERENCE() function, DATE() function	**8 Hours**
Unit-5:	**Grouping & Multi-table Queries** Grouping Results, Summarizing and Aggregating Data, Counting results, Adding Results, Averaging Results, MAX & MIN functions, using HAVING clause with GROUP BY Statements, Implicit Versus Explicit Groups, Counting DISTICT Values Simple Joins/ Equi-Joins, Parent / child queries, Inner Joins, Multiple Joins, Cross Joins, Self Joins, Outer Joins, Right Joins, Left Joins, Full-outer Joins, Creating joins with more than two tables, Equi-Joins Versus Non-Equi Joins, Union operations.	**8 Hours**
Text Books:	1. Beginning SQL, Paul Wilton and John W. Colby, Published by: Wiley Publishing, Inc	
Reference Books:	1. SQL: The Complete Reference, James R. Groff and Paul N. Weinberg, McGraw-Hill/Osborne 2. Learning SQL, ALAN Beaulieu, O'REILLY.	
Additional Electronic Reference Material:	1. http://www.temida.si/~bojan/MPS/materials/Data%20Analysis%20Using%20SQL%20and%20Excel.pdf 2. https://www2.epl.ca/public-files/open-data/2019/introducing-sql-foundation-of-data-analytics.pdf	

Course Code: **IDS507**	**Professional Elective Course-II** **Specialization- Data Science** **B.Tech.- Semester-V** **Data Analytics using Excel**	**L-3 T-0 P-2 C-4**
Course Outcomes:	**On successful completion of the course, students will be:-**	
CO1.	Understanding the importance of Excel for Data Analysis.	
CO2.	Understanding the various Functions and Formulae of Excel Workbook.	
CO3.	Applying Various Statistical Analysis techniques on data using Excel.	
CO4.	Analyzing various analysis techniques for filtering and conditional formatting of data.	
CO5.	Creating flexible data aggregations using pivot tables.	
Course Content:		
Unit-1:	**Functions and Formulas:** Understanding Screen Layout - Creating Auto List & Custom List - Entering, Selecting and Editing Data - Understanding References (Relative, Absolute & Mixed) - Working on Various Functions & Formulas - Common Basic Functions - Logical Functions - Text Functions - Date & Time Functions - Lookup & Reference Functions - Mathematical Functions - Conditional Functions - Referring Data from Different Worksheet & Workbook Formula–Auditing -Various Calculation Techniques - Working on Ranges.	**8Hours**
Unit-2:	**Presentation of Data:** Sorting Techniques - Various Data Filtering Techniques - Formatting Techniques - Conditional Formatting - Number Formatting - Table Formatting - Protecting Sheets & Files - Understanding Various Excel Window Techniques - Viewing Excel Spreadsheet in various Layouts - Advanced Printing Techniques - Templates - Themes.	**8hours**
Unit-3:	**Data Analysis Tools:** Data Consolidation - Text to Columns - Flash Fill - Remove Duplicates - Advanced Data Validation Techniques - What-if Analysis - Goal Seek - Data Table - Solver – Scenarios; Working with Tables - Creating Charts - Understanding Sparklines (Line, Column, Win/Loss) - Pivot Tables & Pivot Charts.	**8 Hours**
Unit-4:	**Data Analysis:** Data Analysis ToolPak – Loading and Activating, ANOVA, correlation, covariance, Descriptive Statistics, Exponential Smoothing, F-Test 2-sample for variances, Fourier Analysis, Histogram, Moving Average, Random Number Generation, Rank and Percentile, Regression, Sampling, t-test, z-test.	**8 Hours**
Unit-5:	**Simulations :**Simulations, Decision Trees and Forecasting, when should we use simulation, simulation modeling cycle, Introduction to Monte Carlo Simulation, generating random values, discrete and	**8Hours**

	continuous functions, Excel for simple simulation, Managerial applications of risk analysis, performing a simulation using @Risk, analyzing the simulation output, generating various plots. Simulation in forecasting, Advanced simulation techniques.	
Text Books:	1. Excel 2016 Bible, John Walkenbach, Wiley, 1st Edition, 2015.	
Reference Books:	1. Microsoft Excel 2013, Data Analysis and Business Modeling: Winston, PHI, 2014 Edition, 2014. 2. Excel Data Analysis for Dummies, Stephen L Nelson, E C Nelson, Wiley, 2nd Edition, 2014. 3. Excel Data Analysis - Modeling and Simulation, Hector Guerrero, Springer, 2010 Edition, 2014. 4. Excel Functions and Formulas, Bernd Held, Theodor Richardson, BPB Publications, 3rd Edition, 2017. *** Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference Material:	1. http://www.temida.si/~bojan/MPS/materials/Data%20Analysis%20Using%20SQL%20and%20Excel.pdf 2. http://excelpro.ir/wp-content/uploads/2015/12/Excel-Data-Analysis-for-Dummies.pdf	

Course Code: IDS508	**Professional Elective Course-II** **Specialization- Data Science** **B.Tech.- Semester-V** **R Programming**	**L-3 T-0 P-2 C-4**
Course Outcomes:	**On successful completion of the course, students will be able to:-**	
CO1.	Understanding the basic programming concepts of R programming language.	
CO2.	Understanding the data structures in R Statistical computing programming language	
CO3.	Understanding the importance of packages and functions in R programming.	
CO4.	Applying the various statistical function on given data sets.	
CO5.	Analyzing the importance of R in statistical analysis and customizing the analysis.	
Course Content:		
Unit-1:	**Introduction to R Environment** History and development of R Statistical computing programming language, installing R and R studio, getting started with R, creating new working directory, changing existing working directory, understanding the different data types, installing the available packages, calling the installed packages, arithmetic operations, variable definition in R, simple functions, vector definition and logical expressions, matrix calculation and manipulation using matrix data types, workspace management.	**8Hours**
Unit-2:	**Data Structures, Looping and Branching** Introduction to different data types, vectors, atomic vectors, types and tests, coercion, lists, list indexing, function applying on the lists, adding and deleting the elements of lists, attributes, name and factors, matrices and arrays, matrix indexing, filtering on matrix, generating a covariance matrix, applying function to row and column of the matrix, data frame – creating, coercion, combining data frames, special types in data frames, applying functions: lapply( ) and sapply( ) on data frames, control statements, loops, looping over non vector sets, arithmetic and Boolean operators and values, branching with **if**, looping with **for**, **if-else** control structure, looping with **while**, vector based programming.	**8hours**
Unit-3:	**R - Object Oriented Programming** Introduction to object oriented concepts in R, basics of S3 classes – S3 Generic functions, OPP in linear model functions, writing S3 classes, using inheritance, introduction to S4 classes, writing S4 Classes, implementing a generic function on an S4 Classes, comparison of S3 and S4 classes, management of objects – listing objects, removing specific objects from the existing function and working directory, saving the collection of objects with save( ) function.	**8 Hours**

Unit-4:	**R for Statistics** Descriptive statistics – mean (arithmetic, geometric and harmonic), median, mode for raw and grouped data, measure of dispersion – range, standard deviation, variance, coefficient of variation, testing of hypothesis – small sample test, large sample test – for comparing mean, proportion, variance, correlation and regression – significance of correlation and regression coefficients, chi-square test, non-parametric test, Analysis of Variance for one way variation and two variation – with and without interaction.	**8 Hours**
Unit-5:	**R with C, C++ and Python** Introduction to C and C++ programming concepts, writing C/C++ functions to be called from R, preliminaries of R to C and C++ programming languages, some mathematical programming example with R and C/C++, compiling and running the code, debugging R/C code, introduction to Python and its components, installing packages related with python in R, syntax of RPy packages.	**8Hours**
Text Books:	1. The art of R programming – Norman Matloff, no starch Press, San Francisco.	
Reference Books:	1. Introduction to Scientific Programming and Simulation using R – Owen Jones, Robert Maillardet and Andrew Robinson, CRC Press 2. Advanced R – Hadley Wickham, CRC Press 3. R in Action – Robert I. Kabacoff, Second Edition, Dreamtech Press. *** Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference Material:	1. https://www.cs.upc.edu/~robert/teaching/estadistica/rprogramming.pdf 2. https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf	

Course Code: **TMUGA-501**	**Specialization- Data Science** **B.Tech- Semester-V** **Modern Algebra and Data Management** **(Value Added Course)**	**L-2** **T-1** **P-0** **C-0**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Applying the concepts of modern mathematics Divisibility rule, Remainder Theorem, HCF /LCM in Number System.	
CO2.	Relating the rules of permutation and combination, Fundamental Principle of Counting to find the probability.	
CO3.	Applying calculative and arithmetical concepts of ratio, Average and Percentage to analyze and interpret data.	
CO4.	Correlating the various arithmetic concepts to check sufficiency of data	
Course Content:		
Unit-1:	**Number theory** Classification of Numbers, Divisibility Rules, HCF and LCM, Factors, Cyclicity(Unit Digit and Last Two digit), Remainder Theorem, Highest Power of a Number in a Factorial, Number of trailing zeroes	**8 Hours**
Unit-2:	**Data interpretation** Data Interpretation Basics, Bar Chart, Line Chart, Tabular Chart, Pie Chart, DI tables with missing values	**7 Hours**
Unit-3:	**Data Sufficiency** Introduction of Data Sufficiency, different topics based DS	**5 Hours**
Unit-4:	**Permutations and combinations** Fundamental counting, and or, arrangements of digits, letters, people in row, identical objects, rank, geometrical arrangements, combination: - basic, handshakes, committee, selection of any number of objects, identical and distinct, grouping and distribution, de-arrangements	**6 Hours**
Unit-5:	**Probability** Introduction, Probability based on Dice and Coins, Conditional Probability, Bayes Theorem	**4 Hours**
Reference Books:	• R1:-Arun Shrama:- How to Prepare for Quantitative Aptitude • R2:-Quantitative Aptitude by R.S. Agrawal • R3:-M Tyra: Quicker Maths • R4:-Nishith K Sinha:- Quantitative Aptitude for CAT • R5:-Reference website:- Lofoya.com, gmatclub.com, cracku.in, handakafunda.com, tathagat.mba, Indiabix.com • R6:-Logical Reasoning by Nishith K Sinha • R7:-Verbal and Non Verbal Reasoning by R.S. Agrawal *** Latest editions of all the suggested books are recommended.**	

Course Code: **TMUGS-501**	**Specialization- Data Science** **BTech- Semester-V** **Managing Self** **(Value Added Course)**	**L-2** **T-1** **P-0** **C-0**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Utilizing effective verbal and non-verbal communication techniques in formal and informal settings	
CO2.	Understanding and analyzing self and devising a strategy for self growth and development.	
CO3.	Adapting a positive mindset conducive for growth through optimism and constructive thinking.	
CO4.	Utilizing time in the most effective manner and avoiding procrastination.	
CO5.	Making appropriate and responsible decisions through various techniques like SWOT, Simulation and Decision Tree.	
CO6.	Formulating strategies of avoiding time wasters and preparing to-do list to manage priorities and achieve SMART goals.	
Course Content:		
Unit-1:	**Personal Development:** Personal growth and improvement in personality Perception Positive attitude Values and Morals High self motivation and confidence Grooming	**10 Hours**
Unit-2:	**Professional Development:** Goal setting and action planning Effective and assertive communication Decision making Time management Presentation Skills Happiness, risk taking and facing unknown	**8 Hours**
Unit-3:	**Career Development:** Resume Building Occupational Research Group discussion (GD) and Personal Interviews	**12 Hours**
Reference Books:	1. Robbins, Stephen P., Judge, Timothy A., Vohra, Neharika, Organizational Behaviour (2018), 18th ed., Pearson Education 2. Tracy, Brian, Time Management (2018), Manjul Publishing House 3. Hill, Napolean, Think and grow rich (2014), Amazing Reads 4. Scott, S.J., SMART goals made simple (2014), Createspace Independent Pub	

	5. https://www.hloom.com/resumes/creative-templates/ 6. https://www.mbauniverse.com/group-discussion/topic.php 7. Rathgeber, Holger, Kotter, John, Our Iceberg is melting (2017), Macmillan 8. Burne, Eric, Games People Play (2010), Penguin UK 9. https://www.indeed.com/career-advice/interviewing/job-interview-tips-how-to-make-a-great-impression *** Latest editions of all the suggested books are recommended.**	

Course Code: IDS601	**Specialization- Data Science** **B.Tech- Semester-VI** **Big data Analytics**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the concept of Hadoop Ecosystem.	
CO2.	Understanding the concept of Different Processing Tool	
CO3.	Understanding the concept of ETL process.	
CO4.	Understanding about various big data technologies used in industry.	
CO5.	Applying different processing tools that help work on Hadoop cluster.	
Course Content:		
Unit-1:	**Understanding BigData** Defining Data, Types of Data, Structured Data, Semi Structured Data, Unstructured Data, How data being Generated, Different source of Data Generation, Rate at which Data is being generated, Different V's, Volume, Variety, Velocity, Veracity, Value, How single person is contributing towards BigData, Significance for BigData, Reason for BigData, Understanding RDBMS and why it is failing to store BigData. Future of BigData, BigData use cases for major IT Industries	**8 Hours**
Unit-2:	**Introduction to Hadoop** What is Hadoop, Apache Community, Cluster, Node, Commodity Hardware, Rack Awareness, History of Hadoop, Need for Hadoop, How is Hadoop Important, Apache Hadoop Ecosystem, Different Hadoop offering , Hadoop 1.x Architecture, Apache Hadoop Framework, Master- Slave Architecture, Advantages of Hadoop.	**8 Hours**
Unit-3:	**Storage Unit** Hadoop Distributed File System, Design of HDFS, HDFS Concept, How files are stored in HDFS, Hadoop File system, Replication factor, Name Node, Secondary Name Node, Job Tracker, Task tracker, Data Node, FS Image, Edit-logs, Check-pointing Concept, HDFS federation, HDFS High availability Architectural description for Hadoop Cluster, When to use or not to use HDFS, Block Allocation in Hadoop Cluster, Read operation in HDFS, Write operation in HDFS, Hadoop Archives, Data Integrity in HDFS, Compression & Input Splits.	**8 Hours**
Unit-4:	**Processing Unit** What is MapReduce, History of MapReduce, How does MapReduce works, Input files, Input Format types Output Format Types, Text Input Format, Key Value Input Format, Sequence File Input Format, Input split, Record Reader, MapReduce overview, Mapper Phase, Reducer Phase, Sort and Shuffle Phase, Importance of MapReduce	**8 Hours**

	Data Flow, Counters, Combiner Function, Partition Function, Joins, Map Side Join, Reduce Side Join, MapReduce Web UI, Job Scheduling, Task Scheduling, Fault Tolerance, Writing MapReduce Application, Driver Class, Mapper Class, Reducer Class, Serialization, File Based Data Structure, Writing a simple MapReduce program to Count Number of words, MapReduce Work Flows	
Unit-5:	**YARN &Hadoop Cluster** YARN, YARN Architecture, YARN Components, Resource Manager, Node Manager, Application Master, Concept of Container, Difference between Hadoop 1.x and 2.x Architecture, Execution of Job in Yarn Cluster, Comparing and Contrasting Hadoop with Relational Databases Cluster Specification, Cluster Setup and Installation, Creating Hadoop user, Installing Hadoop, SSH Configuration, Hadoop Configuration, Hadoop daemon properties, Different modes of Hadoop, Standalone Mode, Pseudo Distributed Mode, Fully Distributed Modes	**8 Hours**
Text Books:	1. Hadoop: The Definitive Guide, By: Tom White, O'REILLY	
Reference Books:	1. Hadoop for Dummies, By: Dirk deRoos, Paul C. Zikopoulos, Bruce Brown, Rafael Coss, and Roman B. Melnyk, A Wiley brand 2. Hadoop in Action, Writer: Chuck Lam Published By: Manning Publications. *** Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference Material:	1. https://mrcet.com/downloads/digital_notes/CSE/IV%20Year/BIG%20DATA%20ANALYSIS%20NOTES.pdf 2. https://www.ti.rwth-aachen.de/teaching/BigData/FBDA.pdf	

Course Code: IDS602	**Specialization- Data Science** **B.Tech- Semester-VI** **Time Series Forecasting**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the different elementary models related to time series analysis.	
CO2.	Understanding the importance of stationarity in building time series models.	
CO3.	Understanding about various methods that used in time series analysis.	
CO4.	Applying different model evaluation technique to identify better model to forecast.	
CO5.	Applying VAR model to the dynamic behavior of financial time series conditions.	
Course Content:		
Unit-1:	**Introduction to Time Series Analysis** Introduction to time series plot in history, time series data and cross sectional data, difference between time series and cross sectional data, time series and stochastic process, means, variances, covariance, stationarity, importance of stationarity in time series analysis, components of time series analysis: trend, seasonal, cyclical and irregular, white noise process, random walk, elementary time series models with zero mean, model evaluation techniques: Bias, MAD, MSE, MAPE.	**8 Hours**
Unit-2:	**Univariate time series analysis – I** Models related to stationary data, Auto Regressive model, Moving Average model, Stationarity of data, concepts on unit root, impacts of unit root in estimating the model parameters, tests related to unit root: Dickey Fuller test, Augmented Dickey Fuller test, KPSS Test, The Phillips Peron Test, seasonal unit roots, periodic integration and unit root testing.	**8 Hours**
Unit-3:	**Univariate time series analysis – II** ARMA (p,q) process, ACF (Auto Correlation Function) and PACF (Partial Auto Correlation Function) of an ARMA (p,q) process, forecasting ARMA process, integration of non-stationary data, first order integration and second order integration, ARIMA (p,i,q), estimation of parameters of ARIMA model, Wald Test Statistic for significance of coeffIDSents.	**8 Hours**
Unit-4:	**Spectral Analysis** Spectral densities, periodogram, he Spectral Representation and Spectral Distribution, Sampling Properties of the Sample Spectral Density, time invariant linear filters, the spectral density of ARMA (Auto Regressive Moving Average), smoothing the Spectral Density, Bias and variance, bandwidth, Confidence Intervals for the Spectrum, Leakage and Tapering, auto regressive spectrum estimation.	**8 Hours**

Unit-5:	**Multivariate Time Series Analysis –VAREstimation** Introduction to multivariate time series analysis, Concepts of Vector Auto Regression, multivariate least square estimation, asymptotic properties of Lease square estimation, Introduction to Vector Error Correction Models, Cointegrated Processes (Johensen Co-integration technique), Common Stochastic Trends, Deterministic Terms in Cointegrated Processes, Forecasting Integrated and Cointegrated Variables, Introduction to Univariate GARCH models, multivariate GARCH, estimation of GARCH models.	**8 Hours**
Text Books:	1. Introductory Econometrics A modern Approach - Jeffrey M. Wooldridge, South-Western Cengage Learning.	
Reference Books:	1. Introduction to Time Series and Forecasting– Peter J. Brockwell Richard A. Davis, Springer 2. Time Series Analysis with applications in R - Jonathan D. Cryer • Kung-Sik Chan, Second Edition, Springer 3. New Introduction to Multiple Time Series Analysis, Helmut Lütkepohl, Springer 4. Basic Econometrics, Fifth Edition - Damodar N. Gujarati, Dawn C. Porter, McGraw-Hill/Irwin Publication. *** Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference Material:	1. https://arxiv.org/ftp/arxiv/papers/1302/1302.6613.pdf#:~:text=In%20time%20series%20forecasting%2C%20past,then%20predicted%20using%20the%20model. 2. https://www.stat.ipb.ac.id/en/uploads/KS/S2%20-%20ADW/3%20Montgomery%20-%20Introduction%20to%20Time%20Series%20Analysis%20and%20Forecasting.pdf	

Course Code: IDS603	**Specialization- Data Science** **B.Tech- Semester-VI** **Inferential Statistics**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the different estimation methods in statistical inference.	
CO2.	Understanding the importance of maximum likelihood estimator in the parameter estimation in continuous probability distributions.	
CO3.	Understanding the importance of Neyman-Pearson lemma in deciding the critical region for the hypothesis testing procedure.	
CO4.	Applying various statistical functions to test the given data sets.	
CO5.	Analyzing the important difference between parametric and non - parametric tests for large and small samples.	
Course Content:		
Unit-1:	**Introduction to Statistical Inference** History and development of statistical inference, introduction to statistical hypothesis, types of hypothesis – simple and composite, fundamental concepts of null hypothesis, alternative hypothesis, critical region, two types of statistical errors: type I and II error, importance of type I & II error, level of significance, confidence level and critical region, most powerful test, uniformly most powerful test and their construction, Neyman Pearson Lemma, application and importance of Neyman Pearson Lemma, unbiased test and unbiased critical region, concepts of likelihood ratio test.	**8 Hours**
Unit-2:	**Testing of Hypothesis – Parametric Test** Introduction to Testing of hypothesis, steps involved in Hypothesis testing, small sample test : t test for one sample mean and two sample mean, F test for equality of two variances, Large sample test : Z test, single mean, two mean, single proportion and two proportions, test for the variance of normal distribution, test for the equality of two or more than two normal distributions, confidence interval for population arithmetic mean, confidence interval for population variance	**8 Hours**
Unit-3:	**Testing of Hypothesis: Non Parametric test** Introduction to non-parametric test, run test, Wilcoxon signed Rank Test, Wilcoxon Matched signed pair rank test, Mann-Whiteney U test, Kruskal Wallis test, Fried Man Rank Test for small sample and large sample, Goodness of fit test and independence of attributes using χ^2 test, testing of equality of more than two variances using χ^2 test	**8 Hours**
Unit-4:	**Parameter Estimation** Introduction to estimation, central limit theorem and its application, types of estimation, properties of good estimator – unbiasedness, consistency, effIDSency and suffIDSency, Method of estimation – maximum likelihood estimation, properties of method of maximum likelihood estimator, estimation of mean and variance of normal distribution using maximum likelihood estimator, introduction and assumptions of ordinary least square	**8 Hours**

	method, estimation of parameters in multiple linear regression coeffIDSents, properties of the OLS method.	
Unit-5:	**Bayesian Statistical Inference** Introduction to Bayes inference, Bayesian Procedures – Prior and posterior distributions, point estimation of Bayesian statistic, Bayesian Interval estimation, Bayesian testing procedures, Bayesian sequential procedures, important terms related to Bayesian statistical inference, introduction to modern Bayesian statistical inference, simple problems related to Bayesian inference and estimations.	**8 Hours**
Text Books:	**1.** Fundamentals of Mathematical Statistics – SC Gupta and VK Kapoor, Sultan Chand & Sons Publication, New Delhi	
Reference Books:	**1.** Introduction to probability Models, Ninth Edition – Sheldon M. Ross, Elsevier Puplication, Academic Press, UK **2.** An introduction to Probability and Statistical Inference – George Roussas, Academic Press *** Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference Material:	3. https://www.student.uwa.edu.au/__data/assets/pdf_file/0019/2633122/Inference2Slides162.pdf 4. https://www.acsu.buffalo.edu/~deannaal/Statistics_Textbook.pdf	

Course Code: **IDS604**	**Specialization- Data Science** **B.Tech- Semester-VI** **Design and Analysis of Algorithm**	**L-3** **T-0** **P-0** **C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the importance of an Algorithm for solving Computer problems.	
CO2.	Understanding the various measures of an Algorithm.	
CO3.	Understanding the concept of Brute force Approaches and its different methods.	
CO4.	Understanding the various elements and efficiency of sorting Algorithms.	
CO5.	Understanding the concepts of Graph and its Traversing methods.	
Course Content:		
Unit-1:	**Role of Algorithms in Computing** Introduction: What is an Algorithm? Notion of Algorithm, Fundamentals of Algorithmic Problem Solving, Role of algorithms in computing, Algorithms as a technology. **Getting Started:** Fundamentals of the Analysis of Algorithm Efficiency, Asymptotic notation and Basic Efficiency Classes, Algorithm design.	**8 Hours**
Unit-2:	**Brute Force Approaches** The method, Exhaustive search – Traveling salesman problem, Selection Sort and Bubble Sort, Sequential Search. **Sorting, Sets and Selection:** Merge sort, Quick sort, Bucket sort, Radix sort.	**8 Hours**
Unit-3:	**Graphs** Graph abstract data type, Data structures for graphs, Graph traversals-BFS, DFS, Directed graphs, weighted graphs.	**8 Hours**
Unit-4:	**Dynamic Programming** The method, Computing of Binomial Coefficient and Fibonacci Series, All pairs shortest path- Floyd's algorithm, Warshall algorithm	**8 Hours**
Unit-5:	**Greedy Algorithms- I** The greedy strategy, Greedy methods & optimization, Topological sort Greed Algorithims-2: Minimum cost spanning trees, Huffman codes, Single source shortest paths-Dijkstra's algorithm	**8 Hours**
Text Books:	1. Data Structures, Algorithms and Applications in C++, SartajSahni,Second Edition. University Press 2005.	
Reference Books:	**1.** Introduction to the Design and Analysis of Algorithms, Anany Levitin, 2 nd Edition, Pearson Education 2007 **2.** An introduction to Probability and Statistical Inference – George Roussas, Academic Press *** Latest editions of all the suggested books are recommended.**	
Additional Electronic	1. http://www.cse.iitd.ernet.in/~ssen/csl356/notes/root.pdf	

Reference Material:	2. https://kailash392.files.wordpress.com/2019/02/fundamentalsof-computer-algorithms-by-ellis-horowitz.pdf	

Course Code: **IDS605**	**Specialization- Data Science** **B.Tech- Semester-VI** **Logical Reasoning and Thinking**	**L-2** **T-0** **P-0** **C-2**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding various verbal activities like synonyms and antonyms.	
CO2.	Understanding various quantitative activities and concepts.	
CO3.	Understanding the concepts of graphs, charts and other data representation.	
CO4.	Applying the various methods to solve quantitative and reasoning problems.	
CO5.	Creating various chart and graph for given data.	
Course Content:		
Unit-1:	**Verbal ability** Synonyms**,** Antonyms and One word substitutes	**6 Hours**
Unit-2:	**Basic quantitative aptitude** Speed, Time and Distance, Time and Work, Linear Equations, Progressions (Sequences & Series), Permutation and Combination, Probability, Functions, Set Theory, Number Systems, LCM and HCF, Percentages, Collection and Scrutiny of data: Primary data, questionnaire and schedule; secondary data, their major sources including some government publications.	**8 Hours**
Unit-3:	**Logical Reasoning - I** Number and Letter Series, Calendars, Clocks, Cubes, Venn Diagrams, Binary Logic, Seating Arrangement, Logical Sequence, Logical Matching, Logical Connectives, Syllogism.	**8 Hours**
Unit-4:	**Measures of Central Tendency** Objective of averaging, characteristics of good average, types of average, arithmetic mean of grouped and ungrouped data, correcting incorrect values, weighted arithmetic mean, Median - median of grouped and ungrouped data merit and limitation of median, computation of quartile, decile and percentile, Mode - calculation of mode of grouped and ungrouped data, merits and limitation of mode, relationship between mean, median and mode. Geometric mean and Harmonic mean.	**8 Hours**
Unit-5:	**Presentation of Data** Construction of tables with one or more factors of classification; Diagrammatic and Graphical representation of non-frequency data; Frequency distribution, cumulative frequency distribution and their graphical representation - histogram, Column Graphs, Bar Graphs, Line Charts, Pie Chart, Data Interpretation – Introduction and	**8 Hours**

	approaches	
Text Books:	1. Quantitative Aptitude by R.S. Agrawal	
Reference Books:	1. Verbal and Non Verbal Reasoning by R.S. Agrawal 2. Statistics for Management, Richard I Levin, David S. Rubin, Pearson Prentice Hall Education Inc. Ltd, NewDelhi, 5th Ed. 2007 3. Business Statistics, Sharma J.K, Pearson Education India, 2010 *** Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference Material:	1. https://www.indiabix.com/logical-reasoning/questions-and-answers/ 2. https://www.freshersnow.com/reasoning-questions-answers/	

Course Code: **IDS651**	**Specialization- Data Science** **B.Tech- Semester-VI** **Design and Analysis of Algorithm (Lab)**	**L-0** **T-0** **P-4** **C-2**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the concept of Data structure.	
CO2.	Understanding the concept of complexity of various algorithms.	
CO3.	Applying the various algorithms to solve programming problems.	
CO4.	Creating a program to perform various sorting algorithms.	
CO5.	Creating a program to perform various algorithms to analyze time complexity.	
Course Content:		
List of Experiment	To implement the following using array as datastructure and analyse its time complexity a. Insertion sort b. Selection sort c. Bubble sort d. Quick sort e. Merge sort f. Bucket sort g. Shell sort h. Radix sort i. Heap sort	
	To implement Linear and Binary search and analyze its time complexity	
	To implement Matrix Chain Multiplication and analyze its time complexity	
	To implement Longest Common Subsequence problem and analyze its time complexity	
	To implement Optimal Binary Search Tree problem and analyze its time complexity	
	To implement Huffman coding and analyze its time complexity	
	To implement Dijkstra's algorithm and analyze its time complexity	
	To implement Bellman Ford algorithm and analyze its time complexity	
	To implement DFS and BFS and analyze their time complexities.	
	To implement following string-matching algorithms and analyze time complexities: a. Naïve b. Rabin karp c. Knuth Morris Pratt	

Course Code: **IDS652**	**Specialization- Data Science** **B.Tech- Semester-VI** **Big data Analytics (Lab)**	**L-0** **T-0** **P-4** **C-2**
Course Outcomes:	**On completion of the course, the students will be :**	
CO.1.	Understanding the concept of Hadoop Cluster	
CO.2.	Understanding the concept of Different Processing Tool	
CO.3.	Applying various processing tool to create Hadoop cluster.	
CO.4.	Creating the Hadoop Ecosystem.	
CO.5.	Creating a program to perform various Hadoop commands.	
Course Content:		
	Experiment 1: Prepare infrastructure and understand objective for software requirement for setting up single node Hadoop cluster. • WinSCP • Putty • Ubuntu • VMPlayer • Hadoop version **Experiment 2:** Create single node Hadoop cluster. • Installing Ubuntu on VM • Installing Java • SSH Configuration • Core-site.xml Configuration • Hdfs-site.xml Configuration • Yarn-site.xml Configuration **Experiment 3:** Testing Single Node cluster, Web UI ports and Exploring different daemons of Hadoop Cluster. **Experiment 4:** Perform / Execute below sets of Hadoop basic commands: • appendToFile • cat • chgrp • chmod • chown • copyFromLocal • copyToLocal • count • cp **Experiment 5:** Perform / Execute below sets of Hadoop basic commands: • du • dus	

- expunge
- get
- getfacl
- getfattr
- getmerge
- ls
- lsr
- mkdir

Experiment 6:

Perform / Execute below sets of Hadoop basic commands:

- moveFromLocal
- moveToLocal
- mv
- put
- rm
- rmr
- setfacl
- setfattr
- setrep
- stat
- tail
- test
- text
- touchz

Experiment 7:

Install eclipse IDE on single node cluster for executing MapReduce Job and understand the role of dependent libraries for processing job.

Experiment 8:

Perform a Map Reduce word count job for a given input file by configuring Number of Reducer 2.

Experiment 9:

Perform a Map Reduce word count job for a given input file by configuring Number of Reducer 6 and Analyze Experiment 8 and 9.

Experiment 10:

Perform a Map Reduce word count job for a given input file by configuring only Mapper (No reducer is involved) and Analyze Experiment 8, 9 and 10.

Experiment 11:

Implement one executable Hadoop MapReduce program to perform the inner join of two tables based on "Student ID" . You can create sample data in below format and can further execute this exercise

Student ID	Name	Year of Birth
201701212	Rahul Anand	1993

Student ID	Score in Semester-1	Score in Semester-2	Score in Semester-3
201701212	88	82	79

Experiment 12:

Implement one executable Hadoop MapReduce program to calculate highest temperature for every given year. You can consider below sample data for executing this job:

Year	Temperature in Degree Centigrade
2000	45
2001	44
2002	39
2001	42
2003	43
2003	44
2003	42.5
2000	44
2005	46
2004	39
2004	39
2004	39.5
2005	45

Course Code: IDS606	**Professional Elective Course-III** **Specialization- Data Science** **B.Tech.- Semester-VI** **Internet of Things**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On successful completion of the course, students will be able to:-**	
CO1.	Understanding the concepts of Internet of things and Internet of Everything.	
CO2.	Understanding about architecture view and strategy of deploying things using cloud.	
CO3.	Understanding the concepts How cloud plays an important role in IoT Infrastructure	
CO4.	Understanding the real time applications and what is future scope related to same.	
CO5.	Analyzing the Privacy and Security issue with IOT devices.	
Course Content:		
Unit-1:	**Introduction to IoT:** M2M to IoT-The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics. M2M to IoT – A Market Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The International driven global value chain and global information monopolies	**8 Hours**
Unit-2:	**IoT Technology Fundamentals & Architecture** M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, M2M and IoT Analytics, Knowledge Management IoT Architecture-State of the Art – Introduction, State of the art, Architecture Reference Model- Introduction, Reference Model, and architecture.	**8 hours**
Unit-3:	**Cloud Computing Basics** Cloud computing components- Infrastructure-services- storage applications-database services – Deployment models of Cloud- Services offered by Cloud- Benefits, and Limitations of Cloud Computing – Issues in Cloud security- Cloud security services and design principle	**8 Hours**
Unit-4:	**IoT – Privacy, Security, and Governance** Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security.	**8 Hours**

Unit-5:	**IoT Applications** Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.	**8Hours**
Text Books:	1. Vijay Madisetti and ArshdeepBahga, **"Internet of Things (A Hands-on-Approach)",** 1stEdition, PVT, 2014.	
Reference Books:	1. Francis daCosta, **"Rethinking the Internet of Things: A Scalable Approach to Connecting Everything",** 1st Edition, Apress Publications, 2013 2. Anthony T.Velte, Toby J.Velte, Robert Elsenpeter, "**Cloud Computing: A Practical Approach**", Tata McGraw Hill Edition, Fourth Reprint, 2010. 3. Kris Jamsa, "**Cloud Computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and more**", Jones & Bartlett Learning Company LLC, 2013. 4. "Internet of Things Applications - From Research and Innovation to Market Deployment " By Ovidiu Vermesan& Peter Friess, ISBN:987-87-93102-94-1, River Publishers ***Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference Material:	1. https://books.google.co.in/books/about/Internet_of_Things.htmJPKGBAAAQBAJ&printsec=frontcover&source=kp_read_button&redir_esc=y#v=onepage&q&f=false 2. https://www.youtube.com/watch?v=LlhmzVL5bm8&vl=en&ab_channel=edureka%21	

Course Code: **IDS607**	**Professional Elective Course-III** **Specialization- Data Science** **B.Tech.- Semester-VI** **Artificial Intelligence**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On successful completion of the course, students will be able to:-**	
CO1.	Understanding the basic principle of AI.	
CO2.	Understanding the structure of intelligent system.	
CO3.	Understanding the concepts of artificial neural networks in Artificial Intelligence.	
CO4.	Understanding the concept of Deep Learning in Artificial Intelligence.	
CO5.	Analyzing the problems that are amenable to solution by AI methods.	
Course Content:		
Unit-1:	**Introduction to AI** What is AI? , Thinking humanly, Acting rationally, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The gestation of artificial intelligence, AI becomes an industry, Knowledge-based systems, The return of neural networks, The State of the Art, Intelligent Agents, How Agents Should Act, Structure of Intelligent Agents, Simple reflex agents, Goal-based agents, Utility-based agents , Environments, Environment programs	**8Hours**
Unit-2:	**Problem-solving** Solving Problems by Searching, Problem-Solving Agents, Formulating Problems, Well-defined problems and solutions, Measuring problem-solving performance, Toy problems, Searching for Solutions, Search Strategies, Avoiding Repeated States, Constraint Satisfaction Search, Informed Search Methods, Best-First Search, Heuristic Functions, Memory Bounded Search, Iterative Improvement Algorithms, Applications in constraint satisfaction problems.	**8hours**
Unit-3:	**Knowledge and reasoning** A Knowledge-Based Agent, Representation, Reasoning, and Logic, Prepositional Logic, An Agent for the Wumpus World, Problems with the propositional agent, First-Order Logic, Syntax and Semantics, Extensions and Notational Variations, Using First-Order Logic, A Simple Reflex Agent, Deducing Hidden Properties of the World, Toward a Goal-Based Agent, Building a Knowledge Base, Knowledge Engineering, Inference Rules Involving Quantifiers, Generalized Modus Ponens, Forward and Backward Chaining, Completeness, Resolution: A Complete Inference Procedure, Completeness of resolution	**8 Hours**

Unit-4:	**Acting logically** A Simple Planning Agent, From Problem Solving to Planning, Planning in Situation Calculus, Basic Representations for Planning, A Partial-Order Planning Algorithm, Planning with Partially Instantiated Operators, Knowledge Engineering for Planning, Practical Planners, Hierarchical Decomposition, Analysis of Hierarchical Decomposition, More Expressive Operator Descriptions, Resource Constraints, Planning and Acting, Conditional Planning, A Simple Re-planning Agent, Fully Integrated Planning and Execution	**8 Hours**
Unit-5:	**Generalized Models** A General Model of Learning Agents, Components of the performance element, Representation of the components, Inductive Learning, Learning Decision Trees, Using Information Theory, Learning General Logical Descriptions, Computational Learning Theory, Learning in Neural and Belief Networks, Neural Networks, Perceptrons, Multilayer Feed-Forward Networks, Bayesian Methods for Learning Belief Networks, Reinforcement Learning, Passive Learning in a Known Environment, Passive Learning in an Unknown Environment, Generalization in Reinforcement Learning	**8Hours**
Text Books:	1. Artificial Intelligence, A Modern Approach, Stuart J. Russell and Peter Norvig	
Reference Books:	1. Artificial Intelligence (Sie) (English, Paperback, Knight Kevin) 2. Artificial Intelligence: An Essential Beginner's Guide to AI, Neil Wilkins ***Latest editions of all the suggested books are recommended.**	
Additional electronic reference material:	1. https://www.tutorialspoint.com/artificial_intelligence/index.htm 2. https://www.youtube.com/watch?v=JMUxmLyrhSk	

Course Code: IDS608	**Professional Elective Course-III** **Specialization- Data Science** **B.Tech.- Semester-VI** **Cloud Computing**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On successful completion of the course, students will be able to:-**	
CO1.	Understanding the concept of cloud, various types of clouds and their working.	
CO2.	Understanding the need for migration on cloud and identify the economic considerations involved.	
CO3.	Understanding the Standards, Organizations and Groups associated with Cloud Computing.	
C04	Understanding the importance of IT governance in cloud computing.	
C05	Analyzing the various Jurisdictional Issues Raised by Virtualization and Data Location.	
Course Content:		
Unit-1:	**Fundamentals of Cloud Computing:** Cloud Computing Basics – History of Cloud Computing, Characteristics of Cloud Computing, Need for Cloud computing, Advantages and Possible Disadvantages of cloud computing, Cloud Deployment Models – Public, Private, Hybrid, Community, Other deployment Models. Evolving Data Center into Private Cloud, Datacenter Components, Extracting Business value in Cloud Computing – Cloud Security, Cloud Scalability, Time to Market, Distribution over the Internet, Cloud Computing Case Studies.	**8Hours**
Unit-2:	**Cloud Delivery Models** Introduction to Cloud Services, **Infrastructure as a Service (IaaS)** – Overview, Virtualization, Container, Pricing Models, Service Level Agreements, Migrating to the Cloud, IaaS Networking options, Virtual Private Cloud(VPC), IaaS Storage – File and Object storage, Data Protection, IaaS security, Benefits, Risks and Examples of IaaS. **Platform as a Service (PaaS)** – Overview, IaaS vs PaaS, PaaS Examples, benefits and risks. **Software as a Service (SaaS)** – Introducing SaaS, SaaS Examples – Office 365, Google G Suite, Salesforce.com , Evaluating SaaS – user and vendor perspective, Impact of SaaS, Benefits and risks of SaaS. Other Services on Cloud, Cloud Delivery Models Considerations	**8hours**

Unit-3:	**Cloud Platforms** Introducing Cloud Platforms, Evaluating cloud platforms, Cloud Platform technologies – Amazon Web Services, Microsoft Azure, Google Cloud Platform, Salesforce.com, Impact of Cloud platforms. Private Cloud Platforms – Introducing Private clouds – Microsoft Azure stack, Open stack, AWS Greengrass, Impact of Private clouds **Cloud Migration** : Delivering Business Processes from the Cloud: Business process examples, Broad Approaches to Migrating into the Cloud, The Seven-Step Model of Migration into a Cloud, Efficient Steps for migrating to cloud., Risks: Measuring and assessment of risks, Company concerns Risk Mitigation methodology for Cloud computing, Case Studies	**8 Hours**
Unit-4:	**Cloud Computing - Challenges, Risk and Mitigation** Cloud Storage, Application performance, Data Integration, Security. **Ensuring Successful Cloud Adoption**: Designing a Cloud Proof of Concept, Vendor roles and capabilities, moving to the Cloud. Impact of Cloud on IT Service Management. **Risks and Consequences of Cloud Computing** – Legal Issues, Compliance Issues, Privacy and Security.	**8 Hours**
Unit-5:	**Managing the Cloud -**Managing and Securing Cloud Services, Virtualization and the Cloud, Managing Desktops and devices on the cloud, SOA and Cloud computing, Managing the Cloud environment, Planning for the Cloud – Economic Cost Model and Leveraging the Cloud, Cloud computing resources, Cloud Dos and Don'ts.	**8Hours**
Text Books:	1. Kirk Hausman, Susan L. Cook, Telmo Sampaio, " CLOUD ESSENTIALS CompTIA® Authorized Courseware for Exam CLO-001", John Wiley & Sons Inc., 2013	
Reference Books:	1. Erl," Cloud Computing: Concepts, Technology & Architecture", Pearson Education, 2014 2. Srinivasan, "Cloud Computing: A Practical Approach for Learning and Implementation "Pearson Education, 2014 3. Judith Hurwitz , Robin Bloor , Marcia Kaufman , Fern Halper, "Cloud Computing for Dummies", Wiley Publishing Inc., 2010 ***Latest editions of all the suggested books are recommended.**	
Additional electronic reference material:	1. https://www.tutorialspoint.com/cloud_computing/cloud_computing_tutorial.pdf 2. https://studytm.files.wordpress.com/2014/03/hand-book-of-cloud-computing.pdf	

Course Code: IDS609	**Professional Elective Course-IV** **Specialization- Data Science** **B.Tech.- Semester-VI** **Block Chain Fundamentals**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On successful completion of the course, students will be able to:-**	
CO1.	Understanding the concepts of Blockchain technology.	
CO2.	Understanding the key concepts like cryptography and cryptocurrency.	
CO3.	Understanding about Bitcoin, its network.	
CO4.	Understanding about different platforms in Block chain like Ethereum.	
CO5.	Analyzing how Bitcoin transactions are validated by miners.	
Course Content:		
Unit-1:	**Introduction** Overview of Block chain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Block chain, Transactions, Distributed Consensus, Types of consensus algorithms, Types of Block chain -Public vs Private Block chain, Understanding Crypto currency, A basic crypto currency	**8 Hours**
Unit-2:	**Understanding Block chain with Cryptography** Overview of Security aspects of Block chain. Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Symmetric key cryptography, Asymmetric key cryptography, Public Key cryptography, Digital Signature	**8 hours**
Unit-3:	**Understanding DLT and Bitcoin** What is DLT, How does it work, DLT and Blockchain related to cryptocurrency, Advantages of DLT, Risks and challenges to DLT, Bitcoin and Block chain, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Mining Difficulty, Consensus in a Bitcoin network: Proof of Work (PoW) – basic introduction, Hashcash PoW, Attacks on PoW and the monopoly problem, Miner, The life of a Bitcoin Miner, Mining Pool.	**8 Hours**
Unit-4:	**Understanding different platforms in Block chain** Overview of Ethereum, Overview of Hyper ledger fabric, Overview of Corda	**8 Hours**
Unit-5:	**Understanding Block chain for Enterprises** Enterprise application of Block chain: Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Block chain, Block chain enabled Trade, We Trade – Trade Finance Network, Supply Chain Financing, and Identity on Block chain	**8 Hours**

Text Books:	1. Melanie Swan, "Block Chain: Blueprint for a New Economy", O'Reilly, 2015	
Reference Books:	1. Josh Thompsons, "Block Chain: The Block Chain for Beginners- Guide to Block chain Technology and Leveraging Block Chain Programming 2. Daniel Drescher, "Block Chain Basics", Apress; 1st edition, 2017 3. Anshul Kaushik, "Block Chain and Crypto Currencies", Khanna Publishing House, Delhi. 4. Imran Bashir, "Mastering Block Chain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Packt Publishing ***Latest editions of all the suggested books are recommended.**	
Additional electronic reference material:	1. http://gunkelweb.com/coms465/texts/ibm_blockchain.pdf 2. https://www.youtube.com/watch?v=UqQMSVfugFA&list=PLsyeobzWxl7oY6tZmnZ5S7yTDxyu4zDW-	

Course Code: IDS610	**Professional Elective Course-IV** **Specialization- Data Science** **B.Tech.- Semester-VI** **Intelligent Processing Automation Fundamentals**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On successful completion of the course, students will be able to:-**	
CO1.	Understanding about Intelligent Processing Automation.	
CO2.	Understanding the importance of automation tools.	
CO3.	Understanding the challenges and risks when implementing automation techniques.	
CO4.	Analyzing technical goals and tradeoffs.	
CO5.	Analyzing the automation and optimization of business process through AI.	
Course Content:		
Unit-1:	**Cognitive Process Automation concepts:** **Introduction to CPA**: Scopes and techniques of CPA, CPA features, CPA platform overview, The future of intelligent automation. **Exploration of the tool:** UiPath architecture, Installing and Learning UiPath studio, UiPath operating model, Database installation	**8 Hours**
Unit-2:	**Automation in UiPath** **UiPath:** Working with different stages, Calculation, Decision, Choice, Collection, Loop, Anchor, Understanding Business objects, Understanding UiPath processes, Pages, Multi Page and page linking, Input, Output and Startup Parameters. **End to End Automation:** Creating and Managing Business objects in object studio, Creating and Managing UiPath processes in process studio, CSV/Excel to data table transfer and vice versa.	**8 hours**
Unit-3:	**UiPath Life Cycle and their artifacts** **User Interface Components:** Ribbon, Toolbars Access, Library panel, project panel, Outline panel, locals panel, Debugging, Recording, Workflow execution, context menu, properties panel, Designer panel, Universal search bar. **UI Automation and System Activities:** UI automation, System, Properties, Variables, Output and Arguments	**8 Hours**
Unit-4:	**Natural Language Processing:** Text Analysis, Text Cleaning, Stemming, TDM and DTM, Sentiment Analysis, NLP API consumption, Build your own social media monitoring tool and Analysis of Email. **Chatbot:** Handling user events and assistant Bots, Monitoring system event triggers, Hotkey triggers, Mouse triggers, System triggers, Launching an assistant bot on a keyboard event.	**8 Hours**
Unit-5:	**Image and Text Automation:** **Image Automation**: Mouse and keyboard activitites, Guides/text activities, OCR- activities,	**8 Hours**

	Types of OCR, Image Activities, Computer Vision, Image classification, Unstructured data to structure conversion, Invoice data extraction. **Text Automation**: Exception Handling, Logging, Debugging, Tracing, Connecting with Database, Executing Query with Database, Project Organization, PDF-data extraction and automation, Email automation.	
Text Books:	1. Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation by Mr Srikanth Merianda.	
Reference Books:	1. Robotic Process Automation- Guide to building robots by Richard Murdoch. 2. Robotic Process Automation and Risk Mitigation: The Definitive Guide by Mary C. Lacity and Dr. Leslie P. Willcocks 3 Intelligenct Control: A stochastic optimization approach by Kaushik Das Sharma, Amitava Chatterjee, Anjan Rakshit. – Springer edition 4. Introduction to robotic process automation by Frank Casale ***Latest editions of all the suggested books are recommended.**	
Additional electronic reference material:	1. https://www.youtube.com/watch?v=MBl-3Yb30FA 2. https://www.ey.com/Publication/vwLUAssets/EY_intelligent_automation/$FILE/EY-intelligent-automation.pdf	

Course Code: **IDS611**	**Professional Elective Course-IV** **Specialization- Data Science** **B.Tech.- Semester-VI** **Recommender System**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On successful completion of the course, students will be:-**	
CO1.	Understanding the basic concepts of recommender systems in data science.	
CO2.	Understanding the different data mining techniques used in recommender system.	
CO3.	Understanding the content based recommender system usage in business scenario.	
CO4.	Analyzing content based and neighbourhood based recommender system	
CO5.	Analyzing various algorithms used for Social Tagging Systems.	
Course Content:		
Unit-1:	**Introduction to Recommender System:** Introduction to recommender system, understanding recommender system, kinds of recommender systems: collaborative filtering recommender system, content based recommender system, knowledge based recommender system, hybrid system, application and evaluation techniques, recommender and human computer interaction, recommender system as multi-disciplinary field, emerging topics and challenges in recommender system	**8Hours**
Unit-2:	**Data Mining Techniques in Recommender System:** Introduction to Data mining techniques, data pre-processing, data mining techniques used in recommender system: similarity measures, sampling, Dimensionality reduction techniques, denoising, k – means clustering, support vector machine, ensemble methods, rule based classifiers, ANN, Bayesian Classifiers, association rule mining.	**8hours**
Unit-3:	**Content Based Recommender System:** Introduction to content based Recommender System, High Level Architecture of Content-based Systems, advantages and drawbacks of Content-based Filtering, item representation, methods for learning user profiles, trends and future research : Role of user generated content in the Recommendation Process, beyond Over-specializion: Serendipity.	**8 Hours**
Unit-4:	**Neighbourhood based Recommender System:** Introduction to neighbourhood based recommender system, definition, overview of recommendation approaches, advantages of neighbourhood based recommender system, neighbourhood-based recommendation: user-based Rating Prediction, user- based classification, regression vs classification, item-based recommendation, comparison of user-based and item-based recommendation, components of	**8 Hours**

	Neighbourhood Methods : Rating normalization, similarity weight computation, neighbourhood selection.	
Unit-5:	**Social Tagging Recommender Systems:** Introduction to Social tagging recommender systems: Folksonomy , the Traditional Recommender Systems Paradigm, multi-Mode recommendations, real World Social Tagging Recommender Systems, tag acquisition, recommendation Algorithms for Social Tagging Systems : collaborative Filtering, recommendation based on Ranking, content-Based Social Tagging Recommendation system, evaluation protocols and metrics.	**8Hours**
Text Books:	1. Recommender Systems Handbook, Francesco Ricci, Lior Rokach, Bracha Shapira, Paul B. Kantor, Springer Science + Business Media, LLC	
Reference Books:	**1.** Recommender Systems An Introduction - DIETMAR JANNACH, MARKUS ZANKER, ALEXANDER FELFERNIG, GERHARD FRIEDRICH, Cambridge University Press **2.** Building a Recommendation System with R - Suresh K. Gorakala, Michele Usuelli, PACKT Publishing. **3.** Recommender Systems for the Social Web – Jose J. Pazos Arias, Ana Fernandez Vilas, Rebeca P. D´ıaz Redondo, Springer Science + Business Media, LLC ***Latest editions of all the suggested books are recommended.**	
Additional electronic reference material:	**1.** https://towardsdatascience.com/introduction-to-recommender-systems-6c66cf15ada	

Course Code: **TMUGA-601**	**Specialization- Data Science** **BTech- Semester-VI** **Advance Algebra and Geometry** **(Value Added Course)**	**L-2** **T-1** **P-0** **C-0**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Recognizing the rules of Crypt-arithmetic and relate them to find out the solutions.	
CO2.	Illustrating the different concepts of Height and Distance and Functions.	
CO3.	Employing the concept of higher level reasoning in Clocks, Calendars and Puzzle Problems.	
CO4.	Correlating the various arithmetic and reasoning concepts in checking sufficiency of data.	
Course Content:		
Unit-1:	**Clocks and calendars** Introduction , Angle based , faulty Clock, Interchange of hands, Introduction of Calendars, Leap Year , Ordinary Year	**5 Hours**
Unit-2:	**Set theory** Introduction , Venn Diagrams basics, Venn Diagram – 3 sets, 4-Group Venn Diagrams	**4 Hours**
Unit-3:	**Heights and Distance** Basic concept, Word problems	**3 Hours**
Unit-4:	**Functions** Introduction to Functions, Even and Odd Functions, Recursive	**3 Hours**
Unit-5:	**Problem Solving** Introduction, Puzzle based on 3 variable, Puzzle based on 4 variable	**6 Hours**
Unit-6:	**Data Sufficiency** Introduction, Blood relation based, direction based, ranking based	**5 Hours**
Unit-7:	**Crypt Arithmetic** Introduction of Crypt Arithmetic, Mathematical operations using Crypt Arithmetic, Company Specific Pattern	**4 Hours**
Reference Books:	• R1:-Arun Shrama:- How to Prepare for Quantitative Aptitude • R2:-Quantitative Aptitude by R.S. Agrawal • R3:-M Tyra: Quicker Maths • R4:-Nishith K Sinha:- Quantitative Aptitude for CAT • R5:-Reference website:- Lofoya.com, gmatclub.com, cracku.in, handakafunda.com, tathagat.mba, Indiabix.com • R6:-Logical Reasoning by Nishith K Sinha • R7:-Verbal and Non Verbal Reasoning by R.S. Agrawal *** Latest editions of all the suggested books are recommended.**	

Course Code: **TMUGS-601**	**Specialization- Data Science** **BTech- Semester-VI** **Managing Work and Others** **(Value Added Course)**	**L-2** **T-1** **P-0** **C-0**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Communicating effectively in a variety of public and interpersonal settings.	
CO2.	Applying concepts of change management for growth and development by understanding inertia of change and mastering the Laws of Change.	
CO3.	Analysing scenarios, synthesizing alternatives and thinking critically to negotiate, resolve conflicts and develop cordial interpersonal relationships.	
CO4.	Functioning in a team and enabling other people to act while encouraging growth and creating mutual respect and trust.	
CO5.	Handling difficult situations with grace, style, and professionalism.	
Course Content:		
Unit-1:	**Intrapersonal Skills:** Creativity and Innovation Understanding self and others (Johari window) Stress Management Managing Change for competitive success Handling feedback and criticism	**8 Hours**
Unit-2:	**Interpersonal Skills:** Conflict management Development of cordial interpersonal relations at all levels Negotiation Importance of working in teams in modern organisations Manners, etiquette and net etiquette	**12 Hours**
Unit-3:	**Interview Techniques:** Job Seeking Group discussion (GD) Personal Interview	**10 Hours**
Text Book	1. Robbins, Stephen P., Judge, Timothy A., Vohra, Neharika, Organizational Behaviour (2018), 18th ed., Pearson Education	
Reference Books:	1. Burne, Eric, Games People Play (2010), Penguin UK 2. Carnegie, Dale, How to win friends and influence people (2004), RHUK 3. Rathgeber, Holger, Kotter, John, Our Iceberg is melting (2017), Macmillan	

	4. Steinburg, Scott, Nettiquette Essentials (2013), Lulu.com *** Latest editions of all the suggested books are recommended.**	
Additional electronic reference material:	1. https://www.hloom.com/resumes/creative-templates/ 2. https://www.mbauniverse.com/group-discussion/topic.php 3. https://www.indeed.com/career-advice/interviewing/job-interview-tips-how-to-make-a-great-impression	

Course Code: **IDS701**	**Specialization- Data Science** **BTech- Semester-VII** **Advanced Big Data Analytics**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the concept of Hadoop Environment.	
CO2.	Understanding the concept of different Processing Tool.	
CO3.	Understanding the frameworks like Pig and Hive.	
CO4.	Understanding the concepts of clustering and Node creation.	
CO5.	Applying the various command use in big data solution.	
Course Content:		
Unit-1:	**Apache Pig** Apache Pig, Pig on Hadoop, Pig Latin, Pig Philosophy, Pig's History, Local Mode and MapReduce Mode, Pig's Data Model, Scalar, Complex, Load, Dump, Store, Foreach, Filter, Join, group, Order by, Distinct, Limit, Sample, Parallel, User Defined Function Advanced Relational Operations, Using different Join Implementations, Co-group, Union, Cross, Nonlinear Data flows, Controlling Executions, Parameter Substitutions, Program for Word Count Job, Comparison Apache Pig and MapReduce	**8 Hours**
Unit-2:	**Apache Hive** Apache Hive, Features of Apache Hive, Command Line Interface, History of Apache Hive, Hadoopdfs commands from Inside Hive, Hive Data Types & Files Formats, Databases in hive, Alter Database, Creating Managed Table, External Table, Partitioned Table, Dropping Tables, Alter Table Loading data into Managed Table, Inserting Data into Tables from Queries, Dynamic Partitions inserts, Exporting data, SELECT from clauses, WHERE Clauses, GROUP BY Clauses, JOIN Statements, ORDER BY, SORT BY, DISTRIBUTE BY, CLUSTER BY, bucketing, UNION ALL, Hive Metastore..	**8 Hours**
Unit-3:	**Sqoop& Flume:** Apache Sqoop, Sqoop Architecture, Sqoop Features, Need for Apache Sqoop, Sqoop Connectors, Import Function, Incremental Import, Direct Mode Import, Performing Export Function, Import to Hive, Exports and Transactionality Apache Flume, Flume Architecture, Features of Apache Flume, Need for Apache Flume, Transactions & Reliability, Source, Sink, Channel , HDFS Sink, Partitioning & Interceptors, File Formats, FAN Out, Integrating Flume with Applications	**8 Hours**
Unit-4:	**Hbase:** Apache Hbase, Understanding Hbase Data Model, Hbase Architecture, HFile, HCatalog, Features of Hbase, Comparing Hbase versus RDBMS, Creating table, Loading Data, Basic Hbase Commands, Alter Table, Deleting Table	**8 Hours**
Unit-5:	**ApacheOozie& Zookeeper:** Apache Oozie, Features of Apache Oozie, Need for Apache Oozie, Workflow.xml, Coordinator, Job properties, Apache Zookeeper, Features and Application of Zookepper, Understanding Concept of Zookeeper.	**8 Hours**
Text Book:	1. Hadoop: The Definitive Guide, By: Tom White, O'REILLY	
Reference Books:	1. Programming Hive, By: Edward Capriolo, Dean Wampler& Jason Rutherglen, Published by O'REILLY	

	2. Programming Pig, By: Alan Gates, Published by O'REILLY 3. Hadoop for Dummies, By: Dirk deRoos, Paul C. Zikopoulos, Bruce Brown, Rafael Coss, and Roman B. Melnyk, A Wiley brand. 4. Hbase The Definitive Guide, By: Lars George, Published by O'REILLY *** Latest editions of all the suggested books are recommended.**	
Additional electronic reference material:	1. https://www.youtube.com/watch?v=1vbXmCrkT3Y 2. https://www.ee.columbia.edu/~cylin/course/bigdata/EECS6895-AdvancedBigDataAnalytics-Lecture1.pdf	

Course Code: IDS702	**Specialization- Data Science** **B.Tech- Semester-VII** **Machine Learning**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the different machine learning techniques and its application.	
CO2.	Understanding the importance of simple linear regression in predicting new observations.	
CO3.	Understanding the importance of assumptions in estimating the parameters in simple linear regression analysis.	
CO4.	Understanding the important multiple linear regression in predictive techniques and its assumptions.	
CO5.	Applying the non-linear model for the new observation predictions and its importance in business.	
Course Content:		
Unit-1:	**Introduction to Machine Learning Algorithms** Introduction to Machine learning – Statistical Learning – types of Machine Learning –learning models: geometric, probabilistic and logistic models, introduction to supervised, unsupervised and reinforcement learning – model evaluation – model implementation – model accuracy indicators.	**8 Hours**
Unit-2:	**Supervised Learning – Simple Linear Regression Analysis** Introduction to parametric machine learning method, assumptions of parametric machine learning methods, linear model and its assumptions, simple linear regression, scatter diagram, Simple linear Regression parameter estimation, properties of regression parameters, testing the significance of regression parameters using ANOVA and t test, estimation of σ^2, Interval Estimation of the Mean Response, R Square, Adjusted R Square, Normality of response variable, prediction of new observations, Confidence interval for β_0, β_1 and σ^2.	**8 Hours**
Unit-3:	**Supervised Learning – Multiple Linear Regression Analysis I** Multiple linear regression model, assumptions of Multiple linear regression variables – multicollinearity, homoscedasticity, autocorrelation, effects of multicollinearity, effect of homoscedasticity and auto autocorrelation in parameter estimation, Least - Squares Estimation of the Regression Coefficients, Geometrical Interpretation of Least Squares, Properties of the Least - Squares Estimators, Estimation of σ^2, Inadequacy of Scatter Diagrams in Multiple Regression.	**8 Hours**
Unit-4:	**Supervised Learning – Multiple Linear Regression Analysis II** Testing the general linear hypothesis, Test for Significance of Regression, Tests on Individual Regression Coefficients and Subsets of Coefficients, Special Case of Orthogonal Columns in X, Confidence Intervals on theRegression Coefficients, CI Estimation of the Mean Response, Simultaneous Confidence Intervals on Regression Coefficients, predicting new observations, residual analysis, model adequacy and validation.	**8 Hours**
Unit-5:	**Supervised Learning – Non Linear Regression Analysis** Introduction to non-linear regression models, non-linear least square method to estimating the regression parameters, transformation of non-linear model to linear model, linearization, other parameter estimation methods, starting values, statistical inference in non-linear regression models.	**8 Hours**
Text Books:	1. Introduction to Machine Learning - EthemAlpaydm, The MIT Press	

Reference Books:	1. Python Machine Learning - Sebastian Raschka, PACKT Publishing 2. Using Multivariate Statistics - Barbara G. Tabachnick, Linda S. Fidell, Pearson Education Inc 3. Introduction to Linear Regression Analysis, Fifth Edition - DOUGLAS C. MONTGOMERY, ELIZABETH A. PECK, G. GEOFFREY VINING, A JOHN WILEY & SONS, INC., PUBLICATION *** Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference Material:	1. https://expertsystem.com/machinelearningdefinition/#:~:text=Machine%20learning%20is%20an%20application,use%20it%20learn%20for%20themselvs	

Course Code: IDS703	**Specialization- Data Science** **BTech- Semester-VII** **Model Validation Techniques**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understanding the different model validation techniques for goodness of fit.	
CO2.	Understanding the concepts of various machine learning methods.	
CO3.	Understanding the concepts of different classification algorithms.	
CO4.	Applying and evaluate model validation techniques for linear model.	
CO5.	Applying model validation technique for classification models.	
Course Content:		
Unit-1:	**Introduction to Model Validation** Definition of statistical model validation, concepts on test, train and validation data, internal and external validation, validity, internal validation techniques: apparent validation, split sample validation, cross validation, bootstrap validation, external validation techniques: temporal validation, geographic validation, fully independent validation, reasons for poor validation.	**8 Hours**
Unit-2:	**General Linear Model Validation** Analysis of Model Coefficients and Predicted Values, stableness, signs and magnitude of of the coefficients, model fit using R Square and adjusted R Square, data splitting, disadvantages of data splitting, double cross validation, variance inflation factors, influence of multicollinearity in model fit, concepts on orthonormalized regressor, stepwise regression - forward selection and backward eliminations, significance level for variable selection, collective significance of regression coefficients, partial t test for individual regression coefficients, Residual analysis – Press Statistic and Cooks Statistics.	**8 Hours**
Unit-3:	**Supervised Learning – Multiple Linear Regression Analysis I** **Generalized Linear Model Validation** Introduction to generalized linear model, difference between general linear model and generalized linear model, likelihood ratio tests, testing goodness of fit, definition of saturated model, deviance, Pearson Chi-Square test statistic, Testing Hypotheses on Subsets of Parameters Using Deviance, Tests on Individual Model Coefficients, Concepts on Hessian matrix, and importance of Hessian Matrix in generalized linear model validation	**8 Hours**
Unit-4:	**Non Parametric model Validation** Introduction to cross validation of different classification algorithms, cross validation and resampling methods : K-fold cross validation, 5X2 cross validation, bootstrapping method, bagging, measurement of error in predictions, confidence interval for the predicted values, confusion matrix and its interpretation, balanced accuracy in confusion matrix, ROC curve for classification algorithms, importance of ROC curve in model accuracy and fit, complexity parameter and its table, pruning using complexity parameter.	**8 Hours**
Unit-5:	**Model Validation – Comparisons** Hypothesis testing – Binomial test, approximate normal test, paired t test, Comparison of two classification algorithms – McNemar's Test, K-Fold Cross validated Paired t test, 5X2 Cross Validated Paired t test, 5X2 Cross Validated Paired F test, ANOVA for comparing more than two	**8 Hours**

	classification algorithms.	
Text Books:	1. Introduction to Linear Regression Analysis, Fifth Edition - Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, A John Wiley & Sons, Inc., Publication	
Reference Books:	1. Fundamentals of mathematical statistics – SC Gupta and VK Kapoor, Sultan Chand & Sons Publication, New Delhi 2. Using Multivariate Statistics, Sixth Edition - Barbara G. Tabachnick, Linda S. Fidell, Pearson Education 3. Applied Regression Analysis, Third Edition – Norman R Draper, Harry Smith, And Wiley Publication. 4. Goodness-of-Fit Tests and Model Validity - C. Huber-Carol, N. Balakrishnan , M.S. Nikulin M. Mesbah , Springer Science + Business Media, LLC *** Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference Material:	1. https://www.youtube.com/watch?v=3x2vCnhiE5U 2. https://www.informs-sim.org/wsc11papers/016.pdf	

Course Code: IDS751	**Specialization- Data Science** **BTech- Semester-VII** **Advanced Big Data Analytics (Lab)**	**L-0** **T-0** **P-4** **C-2**
Course Outcomes:	**On completion of the course, the students will be :**	
CO.1.	Understanding the concept of Hadoop Cluster.	
CO.2.	Applying various methods to setup Hadoop environment.	
CO.3.	Analysing roles and responsibilities of Big Data Administrator.	
CO.4.	Creating a Single Node Hadoop.	
CO.5.	Creating a Hadoop Cluster using different processing tools.	
Experiment 1:	Prepare infrastructure and install Apache Pig on top of Hadoop for data processing.	
Experiment 2:	In this task you have 2 files named as Student and Results. You need to use PIG commands for this task. Step1: Upload this file to Lab through winSCP. Student: Contains names and roll number of students. Results: Contains roll number and results of students whether they passed or failed. Problem Statement: You need to print the name of all the students who failed or passed in the exam based on the given data. (Faculty will share data with students)	
Experiment 3:	Description: Georgia Salary/Travel data provided as CSV file with this assignment for the Fiscal Year 2010 and Organization Type of Local Boards of Education, produce a distinct list of all Job Titles along with the total number of employees aligned with each Job Title & the minimum/maximum/average salaries for each of the identified Job Titles (Data and Data Dictionary will be shared by faculty) Expected Steps: -Store the given input file salaryTravelReport.csv into the HDFS Location - Load the salary file and declare its structure - Loop through the input data to clean up the number fields. Take out the commas from the salary and travel fields and cast to a float - Trim down to just Local Boards of Education - Further trim it down to just be for the year in question - Bucket them up by the job title - Loop through the titles and check how many are there under each title - Determine the minimum, maximum and average salaries for every title - Guarantee the order on the way out - Dump the results on the console - Save results back to HDFS.	
Experiment 4:	To build a script which produces a report listing each Company & State and number of complaints raised by them. Data and Data dictionary will be shared by faculty	
Experiment 5 -6:	a) Prepare infrastructure and install Apache Hive on top of Hadoop for data processing. b) Prepare infrastructure and install mysql on top of Hadoop for data processing. **c)** Test Apache Hive and understand hive Metastore	

Experiment 7:	The dataset provided - MovieLens data sets are collected by the GroupLens Research Project at the University of Minnesota. It represents users' reviews of movies. This data set consists of: * 100,000 ratings (1-5) from 943 users on 1682 movies. * Each user has rated at least 20 movies. * Simple demographic info for the users (age, gender, occupation, zip) u.data -- The full u data set, 100000 ratings by 943 users on 1682 items. Each user has rated at least 20 movies. Users and items are numbered consecutively from 1. The data is randomly ordered. This is a tab separated list: user id | item id | rating | timestamp The time stamps are Unix seconds since 1/1/1970 UTC u.user -- Demographic information about the users; This is a tab separated list: user id | age | gender | occupation | zip code The user ids are the ones used in the u.data data set. (Faculty will share data with students) Find the below problemstatement: 1. Create a u_data table. 2. See the field descriptions of u_data table. 3. Load data into u_data table from a local text file. 4. Show all the data in the newly created u_data table. 5. Show the numbers of item reviewed by each user in the newly created u_data table. 6. Show the numbers of users reviewed each item in the newly created u_data table.	
Experiment 8:	Perform / Execute below sets of problem by referring Experiment Number 07 and find out solutions: 1. Create a u_user table. 2. See the field descriptions of u_user table. 3. Load data into u_user table from a local text file. 4. Show all the data in the newly created user table. 5. Count the number of data in the u_user table. 6. Count the number of user in the u_user table genderwise. 7. join u_data table and u_user tables based on userid and show the top 10 results.	
Experiment 9:	Perform / Execute steps for XML data and Json Data in Apache Hive	
Experiment 10:	Prepare infrastructure and install Apache Sqoop for ETL jobs using MYSQL databases.	
Experiment 11:	Perform / Execute below sets of Apache Sqoop basic commands: • Connecting a Database Server • Selecting the Data to Import	

	• Free-form Query Imports • Controlling Parallelism • Controlling Imports	
Experiment 12:	Perform / Execute below sets of Apache Sqoop basic commands: • Controlling Mapper • File Formats • Large Objects • Importing Data Into Hive • Import all tables • Sqoop Export	

<table>
<tr><td>Course Code:
IDS752</td><td>Specialization- Data Science
BTech- Semester-VII
Machine Learning Lab</td><td>L-0
T-0
P-2
C-1</td></tr>
<tr><td>Course Outcomes:</td><td>On completion of the course, the students will be :</td><td></td></tr>
<tr><td>CO.1.</td><td>Understanding the concept of Machine learning.</td><td></td></tr>
<tr><td>CO.2.</td><td>Understanding the concept of various ML algorithms.</td><td></td></tr>
<tr><td>CO.3.</td><td>Applying various algorithms on given data sets.</td><td></td></tr>
<tr><td>CO.4.</td><td>Analysing the data using R Programming.</td><td></td></tr>
<tr><td>CO.5.</td><td>Creating various chart and graph of given data using machine learning tool.</td><td></td></tr>
<tr><td>Experiment 1:</td><td>
Consider the following table on Air Quality
<table>
<tr><th>S.No</th><th>Ozone</th><th>Solar R</th><th>Wind</th><th>Temp</th><th>Month</th><th>Day</th></tr>
<tr><td>1</td><td>41</td><td>190</td><td>7.4</td><td>67</td><td>5</td><td>1</td></tr>
<tr><td>2</td><td>36</td><td>118</td><td>8</td><td>72</td><td>5</td><td>2</td></tr>
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<tr><td>11</td><td>7</td><td>152</td><td>6.9</td><td>74</td><td>5</td><td>11</td></tr>
<tr><td>12</td><td>16</td><td>256</td><td>9.7</td><td>69</td><td>5</td><td>12</td></tr>
<tr><td>13</td><td>11</td><td>290</td><td>9.2</td><td>66</td><td>5</td><td>13</td></tr>
<tr><td>14</td><td>14</td><td>274</td><td>10.9</td><td>68</td><td>5</td><td>14</td></tr>
<tr><td>15</td><td>18</td><td>65</td><td>13.2</td><td>58</td><td>5</td><td>15</td></tr>
<tr><td>16</td><td>14</td><td>334</td><td>11.5</td><td>64</td><td>5</td><td>16</td></tr>
<tr><td>17</td><td>34</td><td>307</td><td>12</td><td>66</td><td>5</td><td>17</td></tr>
<tr><td>18</td><td>6</td><td>78</td><td>18.4</td><td>57</td><td>5</td><td>18</td></tr>
<tr><td>19</td><td>30</td><td>322</td><td>11.5</td><td>68</td><td>5</td><td>19</td></tr>
<tr><td>20</td><td>11</td><td>44</td><td>9.7</td><td>62</td><td>5</td><td>20</td></tr>
</table>
1. Summarize the above table in R
2. Create the above table in data frame format in R without importing from outer source.
3. Find the linear regression line on given table taking ozone as dependent variable.
4. Predict 21st day of ozone level in the air with given factors.
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</table>

	5. Find the autocorrelation of error produced from the fitted line 6. Analyse multicollinearity among independent variables and find the suitable solution to remove multicollinearity. 7. Find the variance among error terms and comment on the equal variance among error terms in the output. 8. Estimate the presence of autocorrelation using Durbin – Watson test statistic.	
Experiment 2:	1. Estimate appropriate regression line with suitable predictors. Compare different regression lines and comment on regression coefficients. 2. Estimate the significance of regression coefficients using ANOVA and compare with F and partial t test. 3. Model fit using R Square and Adjusted R square values. 4. Estimate Cook Statistic and Press Statistic for diagnostic checking 5. Post model statistical testing for the better fit and error free prediction. 6. Normality testing on error terms of fitted model	
Experiment 3:	1. Plot residual versus Fitted values using plot command 2. Plot residual versus Observed using Plot command 3. Plot observed versus and fitted values using plot command 4. Find out the leverage value in the fitted values using which.max command. 5. Interpret the residual summary from the lm( ) command. 6. Find out the VIF values using inbuilt function available in R.	

Course Code: **IDS753**	**Specialization- Data Science** **B.Tech.- Semester-VII** **Mini Project(Lab)**	**L-0** **T-0** **P-2** **C-1**
Course Outcomes:	**On completion of the course, the students will be :**	
CO1.	Understand methodologies and professional way of documentation and communication.	
CO2.	Understanding practical knowledge within the chosen area of technology for project development.	
CO3.	Applying technical knowledge to solve the real-life problems.	
CO4.	Analyzing programming projects with a comprehensive and Systematic approach.	
CO5.	Developing effective communication skills for presentation of project related activities.	
Course Content:	The students will undertake a mini project as part of their seventh semester. The students can do independent projects or can take up projects in groups of two or more depending on the complexity of the project. The maximum group size will be four and in case of team projects there should be a clear delineation of the responsibilities and work done by each project member. The projects must be approved by the mentor assigned to the student. The mentors will counsel the students for choosing the topic for the projects and together they will come up with the objectives and the process of the project. From there, the student takes over and works on the project.	
Bridge Course	The bridge course ensures that all the students have the correct prerequisite knowledge before their industry interface. The purpose of a bridge course is to prepare for a healthy interaction with industry and to meet their expectations. It would be difficult to establish standards without appropriate backgrounds and therefore to bridge this gap, students are put through a week mandatory classroom participation where faculty and other experts will give adequate inputs in application based subjects, IT and soft skills.	
The Project	Each student will be allotted a Faculty Guide and an Industry Guide during the internship/project work. Students need to maintain a Project Diary and update the project progress, work reports in the project diary. Every student must submit a detailed project report as per the provided template. In the case of team projects, a single copy of these items must be submitted but each	

	team member will be required to submit an individual report detailing their own contribution to the project. Each student/group should be allotted a supervisor and periodic internal review shall be conducted which is evaluated by panel of examiners.	
Project Evaluation Guidelines	The Project evaluator(s) verify and validate the information presented in the project report. The break-up of marks would be as follows: 1. Internal Evaluation 2. External Assessment 3. Viva Voce	
Internal Evaluation	Internal Evaluator of project needs to evaluate Internal Project work based on the following criteria: ● Project Scope , Objectives and Deliverables ● Research Work, Understanding of concepts ● Output of Results and Proper Documentation ● Interim Reports and Presentations– Twice during the course of the project	
External Evaluation	The Project evaluator(s) perform the External Assessment based on the following criteria. ● Understanding of the Project Concept ● Delivery Skill ● The Final Project Report ● Originality and Novelty	

Course Code: **IDS754**	**Specialization- Data Science** **B.Tech.- Semester-VII** **Industrial Training Seminar**	**L-0** **T-0** **P-2** **C-1**
Course Outcomes:	**On successful completion of the course, students will be:-**	
CO1.	Understanding the past and present of the disciplines by exploring their purpose, practice, and philosophy.	
CO2.	Understanding of advanced research methodologies in the field, including theory, interdisciplinary approaches, and the analysis of available primary sources.	
CO3.	Understanding the privileges and obligations associated with a career as a professional	
CO4.	Understanding historical and recent trends in theory and method and be able to identify and explain major trends and issues in industry and research.	
CO5.	Applying technical skill to solve industry problems.	
Course Content:		
	Students will have to undergo industrial training of minimum four weeks in any industry or reputed organization after the VI semester examination in summer. The evaluation of this training shall be included in the VII semester evaluation. The student will be assigned a faculty guide who would be the supervisor of the student. The faculty would be identified before the end of the VI semester and shall be the nodal officer for coordination of the training. Students will prepare an exhaustive technical report of the training during the VII semester which will be duly signed by the officer under whom training was undertaken in the industry/ organization. The covering format shall be signed by the concerned office in-charge of the training in the industry. The officer-in-charge of the trainee would also give his rating of the student in the standard University format in a sealed envelope to the Principal of the college. The student at the end of the VII semester will present his report about the training before a committee constituted by the Director of the College which would comprise of at least three members comprising of the Department Coordinator, Class Coordinator and a nominee of the Director. The students guide would be a special invitee to the presentation. The seminar session shall be an open house session. The internal marks would be the average of the marks given by each member of the committee separately in a sealed envelope to the Director. The marks by the external examiner would be based on the report submitted by the student which shall be evaluated by the external examiner and cross examination done of the student concerned. Not more than three students would form a group for such industrial training/ project submission. The marking shall be as follows. **Internal: 50 Marks** By the faculty guide - 25 marks	

	By committee appointed by the director – 25 marks **External: 50 Marks** By officer-in-charge trainee in industry – 25 marks By external examiner appointed by the university – 25 marks	

Course Code: IDS704	**Professional Elective Course-V** **Specialization- Data Science** **B.Tech.- Semester-VII** **Predictive Analytics**	**L-2 T-1 P-0 C-3**
Course Outcomes:	**On successful completion of the course, students will be:-**	
CO1.	Understanding the important terminologies and need for predictive analytics for business organization.	
CO2.	Applying data pre-processing techniques for predictive analytics.	
CO3.	Applying data wrangling techniques for predictive analytics.	
CO4.	Applying linear regression analysis and fine tune the model for higher accuracy.	
CO5.	Applying classification techniques and fine tune the model for higher accuracy	
Course Content:		
Unit-1:	**Introduction to predictive modelling:** History and Evolution, Scope of predictive modelling: Ensemble of statistical algorithms, Statistical tools, Historical data, Mathematical function, Business context, Data Mining, Data Analytics, Data science, Statistics, Statistics vs Data Mining vs Data Analytics vs Data Science, machine learning packages available in statistical programming software: Anaconda, Standalone Python, R, R studio, Data Analysis Packages related to R and Python Installing Python or R packages for predictive modelling. Reading the data – variations and examples, Various methods of importing data in to statistical software: reading a dataset using the read_csv method, reading a dataset using the open method of Python or R, reading data from a URL, miscellaneous cases - Reading from an .xls or .xlsx fle, summary, dimensions, and structure Handling missing values: Checking for missing values, Treating missing values: deletion and imputation, Creating dummy variables, Visualizing a dataset by basic plotting: scatter plots, histograms, boxplots..	**8Hours**
Unit-2:	**Data Wrangling:** Introduction, need for data wrangling, Sub setting a dataset: Selecting columns, selecting rows, Selecting a combination of rows and columns, Creating new columns, Generating random numbers and their usage: Various methods for generating random numbers, Seeding a random number, Generating random numbers following probability distributions, Probability density function, Cumulative density function, Uniform distribution, Normal distribution, Using the Monte-Carlo simulation to find the value of pi, Generating a dummy data frame, Grouping the data – aggregation, filtering, and transformation, Random sampling – splitting a dataset in training and testing datasets, Concatenating and appending data, Merging/joining datasets	**8hours**
Unit-3:	**Linear Regression:** Definition and overview of linear regression analysis, Linear regression using simulated data, fitting a linear regression model and	**8 Hours**

	checking its efficacy, Finding the optimum value of variable coefficients, Making sense of result parameters, p-values, F-statistics, Residual Standard Error, Implementing linear regression with Statistical software, Linear regression using the available statistical software library in R or Python, Multiple linear regression, Multi-collinearity: Variance Inflation Factor, Model validation, Training and testing data split, Summary of models, Linear regression with R or Python, Feature selection with suitable packages in R or Python, Handling other issues in linear regression: Handling categorical variables, Transforming a variable to fit non-linear relations, Handling outliers.	
Unit-4:	**Classification Techniques:** Introduction and definition to classification techniques, Contingency tables, conditional probability, odds ratio, Moving on to logistic regression from linear regression, Estimation using the Maximum Likelihood Method, Making sense of logistic regression parameters, Wald test, Likelihood Ratio Test statistic, Chi-square test, Implementing logistic regression decision tree, Random forest, support vector machine, neural network.	**8 Hours**
Unit-5:	**Evaluation of Predictive Models:** Model validation and evaluation, Model validation, ROC Curve, Confusion Matrix, Introduction to decision trees, Understanding the mathematics behind decision trees and ensemble tree methods: Homogeneity, Entropy, Information gain, ID3 algorithm to create a decision tree, Gini index, Reduction in Variance, Pruning a tree, handling a continuous numerical variable and missing values, Regression tree algorithm, implementing a regression tree using Python, Understanding and implementing random forests using python	**8Hours**
Text Books:	**1.** Learning Predictive Analytics with Python– Ashish Kumar, PACKT Publishing.	
Reference Books:	1. Data Mining and Predictive Analytics – Daniel T. Larose, Chantal D. Larose, Wiley 2. Mastering Machine Learning with Python in Six Steps- Manohar Swamynathan, Apress 3. Mastering Predictive Analytics with Python - Joseph Babcock, PACKT Publishing. 4. R in Action, Second Edition – Robert I. Kabacoff, Dreamtech Press *** Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference Material:	1. https://www.youtube.com/watch?v=Cx8Xie5042M 2. https://www.predictiveanalyticsworld.com/book/pdf/Predictive_Analytics_by_Eric_Siegel_Excerpts.pdf 3. http://download.101com.com/pub/tdwi/Files/PA_Report_Q107_F.pdf	

Course Code: **IDS705**	**Professional Elective Course-V** **Specialization- Data Science** **B.Tech.- Semester-VII** **Social Media Analytics**	**L-2 T-1 P-0 C-3**
Course Outcomes:	**On successful completion of the course, students will be:-**	
CO1.	Understand the important terminologies and analytics techniques in social media analytics.	
CO2.	Analyzing the twitter data and conclude the important finding and insights of the society thought on particular issues.	
CO3.	Analyzing the facebook data and conclude the important finding and insights of the society thought on particular issues.	
CO4.	Analyzing the Instagram profile and find out the interesting insights.	
CO5.	Analyzing the GitHub profile and find out the latest trending article in GitHub	
Course Content:		
Unit-1:	Introduction to Social Media Analytics: History and Evolution of social media, impact of social media in growth of business, Social media and its importance, Various social media platforms, Social media mining, Challenges for social media mining, Social media mining techniques: Graph mining and text mining, The generic process of social media mining: Getting authentication from the social website, Data visualization R packages, The simple word cloud, Sentiment analysis Word cloud, Preprocessing and cleaning in R.	**8Hours**
Unit-2:	Analytics on Twitter: Introduction, Twitter and its importance, Understanding Twitter's APIs: Twitter vocabulary, Creating a Twitter API connection: Creating a new app, Finding trending topics, Searching tweets, Twitter sentiment analysis: Collecting tweets as a corpus, Cleaning the corpus, Estimating sentiment	**8hours**
Unit-3:	Analytics on Facebook: Introduction, importance of Facebook, Creating an app on the Facebook platform, facebook package installation and authentication, Installation, A closer look at how the package works, A basic analysis of your network, Network analysis and visualization: Social network analysis, Degree, Betweenness, Closeness, Cluster, Communities, Getting Facebook page data, Trending topics analysis, Influencers: based on single post and multiple post, Measuring CTR performance for a page, Spam detection, Recommendations to friends.	**8 Hours**

Unit-4:	Analytics on Instagram: Definition and overview Instagram and its role in social awareness, Creating an app on the Instagram platform, Installation and authentication of the insta package, Accessing data from R: Searching public media for a specific hashtag, Searching public media from a specific location, Extracting public media of a user, Extracting user profile, Getting followers, Getting comments, Number of times hashtag is used, Building a dataset: User profile, User media, Travel-related media, Popular personalities: Who has the most followers? Who follows more people? Who shared most media? Overall top users, Most viral media, Finding the most popular destination, Locations with most likes, Locations most talked about, Clustering the pictures, Recommendations to the users.	**8 Hours**
Unit-5:	Analytics on GitHub: Introduction to GitHub, creating an app on GitHub, GitHub package installation and authentication, Accessing GitHub data, Building a heterogeneous dataset using the most active users, Building additional metrics, Exploratory data analysis, EDA – graphical analysis: Which language is most popular among the active GitHub users? What is the distribution of watchers, forks, and issues in GitHub? How many repositories had issues? What is the trend on updating repositories? Compare users through heat map, EDA – correlation analysis: How Watchers is related to Forks, Correlation with regression line, Correlation with local regression curve, Correlation on segmented data, Correlation between the languages that user's use to code, how to get the trend of correlation?.	**8Hours**
Text Books:	1. Mastering Social Media Mining with R– Sharan Kumar Ravindran, Vikram Garg, PACKT Publishing. 2. Social Media Mining with R - Nathan Danneman, Richard Heimann, PACKT Publishing.	
Reference Books:	1. SOCIAL MEDIA MINING An Introduction - REZA ZAFARANI, MOHAMMAD ALI ABBASI, HUAN LIU, CAMBRIDGE University Press.	

	*** Latest editions of all the suggested books are recommended.**	
Additional Electronic Reference Material:	1. https://www.youtube.com/watch?v=OOorJb1AfYA 2. https://www.upa.it/static/upload/the/the-fundamentals-of-social-media-analytics.pdf	

Course Code: IDS706	**Professional Elective Course-V** **Specialization- Data Science** **B.Tech.- Semester-VII** **Pattern Recognition**	**L-2 T-1 P-0 C-3**
Course Outcomes:	**On successful completion of the course, students will be:-**	
CO1.	Understanding the basic concepts of pattern recognition.	
CO2.	Understanding the various pattern recognition approaches.	
CO3.	Applying various statistical pattern recognition techniques.	
CO4.	Analyzing the statistical and syntactical pattern recognition techniques.	
CO5.	Analyzing the various neural network techniques in pattern recognition.	
Course Content:		
Unit-1:	**PATTERN RECOGNITION OVERVIEW** Pattern recognition, Classification and Description—Patterns and feature Extraction with Examples—Training and Learning in PR systems—Pattern recognition Approaches	**8Hours**
Unit-2:	**STATISTICAL PATTERN RECOGNITION** Introduction to statistical Pattern Recognition—supervised Learning using Parametric and Non Parametric Approaches.	**8hours**
Unit-3:	**LINEAR DISCRIMINANT FUNCTIONS AND UNSUPERVISED LEARNING AND CLUSTERING** Introduction—Discrete and binary Classification problems—Techniques to directly Obtain linear Classifiers -- Formulation of Unsupervised Learning Problems— Clustering for unsupervised learning and classification.	**8 Hours**
Unit-4:	**SYNTACTIC PATTERN RECOGNITION** Overview of Syntactic Pattern Recognition—Syntactic recognition via parsing and other grammars–Graphical Approaches to syntactic pattern recognition—Learning via grammatical inference.	**8 Hours**
Unit-5:	**NEURAL PATTERN RECOGNITION** Introduction to Neural networks—Feedforward Networks and training by Back Propagation—Content Addressable Memory Approaches and Unsupervised Learning in Neural PR.	**8Hours**
Text Books:	1. Bishop C.M., "Neural Networks for Pattern Recognition", Oxford University Press, 1995.	

Reference Books:	1. Robert Schalkoff, "Pattern Recognition: Statistical Structural and NeuralApproaches", John wiley&sons , Inc,1992. 2. Earl Gose, Richard johnsonbaugh, Steve Jost, "Pattern Recognition and ImageAnalysis", Prentice Hall of India,.Pvt Ltd, New Delhi, 1996. 3. Duda R.O., P.E.Hart& D.G Stork, " Pattern Classification", 2nd Edition, J.WileyInc 2001. 4. Duda R.O.& Hart P.E., "Pattern Classification and Scene Analysis", J.wileyInc, 1973. *** Latest editions of all the suggested books are recommended.**	
Additional electronic reference material:	1. http://users.isr.ist.utl.pt/~wurmd/Livros/school/Bishop%20Pattern%20Recognition%20And%20Machine%20Learning%20-%20Springer%20%202006.pdf	

Course Code: IDS707	**Professional Elective Course-VI** **Specialization- Data Science** **B.Tech.- Semester-VII** **Business Intelligence**	**L-2 T-1 P-0 C-3**
Course Outcomes:	**On successful completion of the course, students will be:-**	
CO1.	Understanding the important terminologies and architecture of Business Intelligence system.	
CO2.	Understanding the important difference between business performance management and business intelligence.	
CO3.	Understanding the different OLAP systems used in Business Intelligence Report creations and analytics.	
CO4.	Understanding the different business intelligence types, and importance of report creation and dashboard design.	
CO5.	Understanding implementation procedure for business intelligence systems.	
Course Content:		
Unit-1:	Introduction to Business Intelligence: Introduction to Business Intelligence, A Framework for Business Intelligence (BI), Definitions of BI, A Brief History of BI The Architecture of BI, Styles of BI, The Benefits of BI, Event-Driven Alerts, Intelligence Creation and Use and BI Governance, A Cyclical Process of Intelligence Creation and Use, Intelligence and Espionage, Transaction Processing versus Analytic Processing, Successful BI Implementation, The Typical BI user Community, Appropriate Planning and Alignment with the Business Strategy, Real-Time, On-Demand BI Is Attainable, Developing or Acquiring BI Systems, Justification and Cost-Benefit Analysis, Security and Protection of Privacy, Integration of Systems and Applications , Major Tools and Techniques of Business Intelligence.	**8Hours**
Unit-2:	Business Performance Management: Business Performance Management (BPM) Overview, BPM Defined, Comparison of BPM and BI, Operational Planning, Financial Planning and Budgeting, Pitfalls of Variance Analysis, Act and Adjust: What Do We Need to Do Differently?, Performance Measurement, Key Performance Indicators (KPI) and Operational Metrics, Problems with Existing Performance Measurement Systems, Effective Performance Measurement, BPM Methodologies, Balanced Scorecard (BSC) , Six Sigma, BPM Technologies and Applications, BPM Architecture, Commercial BPM Suites, BPM Market versus the BI Platform Market, Performance Dashboards and Scorecards, Dashboards versus Scorecards, Dashboard Design, important properties of design of dash boards.	**8hours**
Unit-3:	Business Intelligence: Stages: Introduction, Extract, Transform, and Load), Data Warehouse, Data Warehouse Architecture, Design of Data	**8 Hours**

	Warehouses, Dimensions and Measures, Data Warehouse Implementation Methods: Top-Down Approach, The Bottom-Up Approach, The Federated Approach, The Need for Staged Data, Integrating Data from Multiple Operating Systems, OLAP, Types of OLAP, Multidimensional OLAP (MOLAP), Relational OLAP (ROLAP), Hybrid OLAP (HOLAP), Data Mining, Data Mining and Statistical Analysis, Data-Mining Operations, Data Mining—Data Sources, Data Dredging, Data Management, Data Usage, Enterprise Portal (EP)	
Unit-4:	Types of Business Intelligence: Multiplicity of BI Tools, The Problem with Multiple BI Tools, Types of BI, Enterprise Reporting, Cube Analysis, Ad Hoc Query and Analysis, Statistical Analysis and Data Mining, Alerting and Report Delivery, Modern BI, Enterprise Reporting, Support for Different Forms and Types, Support for Personalization and Customization, Support for Wide Reach, High Throughput and Access across All Touch Points, The Enterprise BI, Single Unified User Interface, Single Unified Backplane, Vision of a Critical BI System, Centralized Business Logic, Flexible Data Structures, Advanced Analytics, Reporting, Rich Report Design, Flexible Information Delivery, Self-Service Reporting, Critical BI for the Enterprise	**8 Hours**
Unit-5:	Business Intelligence Implementation: Introduction, Implementation of BI System: An Overview, BI Implementations Factors, Managerial Issues Related to BI Implementation , BI and Integration Implementation, Types of Integration, Levels of BI Integration, Embedded Intelligent Systems, Connecting BI Systems to Databases and Other Enterprise Systems, Connecting to Databases, Integrating BI Applications and Back-End Systems, Middleware, On-Demand BI, The Limitations of Traditional BI, The On-demand Alternative, Key Characteristics and Benefits, Issues of Legality, Privacy, and Ethics, Legal Issues, Privacy, Ethics in Decision Making and Support.	**8Hours**
Text Books:	1. Business Intelligence: A Managerial Approach, 2nd Edition - Turban, Sharda Efraim; Ramesh, Dursun Delen and King, David. (2011), Prentice Hall.	
Reference Books:	1. Data Mining: Concepts and Techniques, Second Edition - Han, Jiawei and Kamber, Micheline. (2009). San Francisco: Morgan Kaufmann Publishers. 2. Business Analysis for Business Intelligence - Bert Brijs, CRC Press. 3. Business Intelligence for Telecommunications – Deepak Pareek, Auerbach Publications.	

	*** Latest editions of all the suggested books are recommended.**	
Additional electronic reference material:	1. https://www.youtube.com/watch?v=5nGqJPkRC8o&list=PLQVJk9oC5JKpNXRylsGssRMpGp9n5DN0v 2. https://www.redbooks.ibm.com/redbooks/pdfs/sg245747.pdf	

Course Code: **IDS708**	**Professional Elective Course-VI** **Specialization- Data Science** **B.Tech.- Semester-VII** **Data Visualization**	**L-2** **T-1** **P-0** **C-3**
Course Outcomes:	**On successful completion of the course, students will be:-**	
CO1.	Understand the application of different visualization tool for the business report representation.	
CO2.	Understand the different visualization techniques to find out the distribution of data set.	
CO3.	Understand the importance of visualization in multivariate environment.	
CO4.	Understand the importance of customization of graphical representation of data in business communication.	
CO5.	Analyzing various type of plotting method use in graphical validation.	
Course Content:		
Unit-1:	**Introduction to Data Visualization** Brief history of data visualization, scientific design choices in data visualization- choice of graphical form, grammar of graphical techniques of large amount of data, crucial need of visualization techniques, challenges in visualization techniques, classification of visualization techniques for qualitative and quantitative data, power of visualization techniques, introduction to different visualization techniques	**8Hours**
Unit-2:	**Static Graphical Techniques – 1** Introduction to bar graph, basic understanding of making basic bar graph, grouping bars together, bar graphs on counts, customization of bar graphs by changing colour, size, title, axis units, changing width and spacing of the bar chart, adding labels to bar graph, application of bar graph in business.	**8hours**
Unit-3:	**Multivariate Graphical Techniques** Introduction to correlation matrix, application of correlation matrix in the multivariate analysis, network graph, basics of heat map, difference between heat map and tree map, introduction to higher dimensional scatter plot, axis adjustment in the higher dimensional scatter plot, addition of prediction surface of higher dimensional scatter plot	**8 Hours**

Unit-4:	**Graphical Validation** Basics of multivariate statistical visual representations and its results, dendrogram, importance of dendrogram in grouping (cluster analysis), Scree Plot, importance of Scree Plot, application of Scree Plot in determining number of clusters and factors, QQ plot, importance of QQ plot in distribution of data for the further quantitative analysis, PP plot, applications and usage of PP Plot for distribution detection	**8 Hours**
Unit-5:	**Customization** Introduction to annotations – adding : text, mathematical expression , lines, arrows, shaded shapes, highlighting the texts and items, adding error bars, introduction to axis, swapping x and y axis, changing the scaling ration in the axis, positioning of axis and arranging tick marks and labels, changing the appearance of axis labels, circular graphs, using themes, changing the appearance of theme elements, creating the own themes, legends : removing the legends, position of legends, legend title, labels in legends	**8Hours**
Text Books:	1. DATA VISUALIZATION PRINCIPLES AND PRACTICE, SECOND EDITION - Alexandru Telea, CRC Press.	
Reference Books:	1. R Graphics Cook Book, Winston Chang, First Edition, O'Reilly Publication. 2. ggplot2 Elegant Graphics for Data Analysis – Hadley Wickham, Springer Publication 3. Hand book of Data Visualization – Chun-houh Chen, Wolfgang Härdle, Antony Unwin, Springer Publication. *** Latest editions of all the suggested books are recommended.**	
Additional electronic reference material:	4. https://www.youtube.com/watch?v=MiiANxRHSv4 5. https://homes.cs.washington.edu/~jheer/talks/Heer-EffectiveDataVisualization.pdf 6. https://www.netquest.com/hubfs/docs/ebook-data-visualization-EN.pdf?hsCtaTracking=522c24a0-0231-40c5-9fdd-c449a5b64b92%7C174f96ae-1e66-4aec-9aa3-c7478eb1390d	

Course Code: IDS709	**Professional Elective Course-VI** **Specialization- Data Science** **B.Tech.- Semester-VII** **Design Thinking**	**L-2 T-1 P-0 C-3**
Course Outcomes:	**On successful completion of the course, students will be:-**	
CO1.	Understanding the ethical and social dilemmas and obligations of the practice of design.	
CO2.	Understanding complex and unstructured problem-solving challenges in unfamiliar domains	
CO3.	Applying new methods that lead innovation in creative and collaborative settings.	
CO4.	Analyzing common adoption barriers in individuals, groups and organizations.	
CO5.	Developing a design theory from independent and qualitative research and observations.	
Course Content:		
Unit-1:	PROCESS OF DESIGN Introduction – Product Life Cycle - Design Ethics - Design Process - Four Step - Five Step - Twelve Step - Creativity and Innovation in Design Process - Design limitation.	**8Hours**
Unit-2:	GENERATING AND DEVELOPING IDEAS Introduction - Create Thinking - Generating Design Ideas - Lateral Thinking – Anologies – Brainstorming - Mind mapping - National Group Technique – Synectics - Development of work - Analytical Thinking - Group Activities Recommended.	**8hours**
Unit-3:	REVERSE ENGINEERING Introduction - Reverse Engineering Leads to New Understanding about Products - Reasons for Reverse Engineering - Reverse Engineering Process - Step by Step - Case Study.	**8 Hours**
Unit-4:	BASICS OF DRAWING TO DEVELOP DESIGN IDEAS Introduction - Many Uses of Drawing - Communication through Drawing - Drawing Basis – Line - Shape/ Form – Value – Colour – Texture - Practice using Auto CAD recommended.	**8 Hours**
Unit-5:	TECHNICAL DRAWING TO DEVELOP DESIGN	**8Hours**

	Introduction - Perspective Drawing - One Point Perspective - Two Point Perspective - Isometric Drawing - Orthographic Drawing - Sectional Views - Practice using Auto CAD recommended	
Text Books:	1. John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage learning (International edition) Second Edition, 2013	
Reference Books:	1. Yousef Haik and Tamer M.Shahin, "Engineering Design Process", Cengage Learning, Second Edition, 2011. *** Latest editions of all the suggested books are recommended.**	
Additional electronic reference material:	1. https://www.tutorialspoint.com/hi/design_thinking/ 2. design_thinking_tutorial.pdf	

Course Code: **IDS851**	**Specialization- Data Science** **B.Tech.- Semester-VIII** **Industry Internship**	**L-0** **T-0** **P-20** **C-10**
Course Outcomes:	**On successful completion of the course, students will be:-**	
CO1.	Understanding to take initiatives, communicate, work in a team and manage a project within a given time frame.	
CO2.	Understanding the use of interpretation and application of an appropriate international engineering standard in a specific situation.	
CO3.	Applying prior acquired knowledge in problem solving.	
CO4.	Analyzing a given engineering problem and use an appropriate problem solving methodology.	
CO5.	Analyzing sources of hazards, and identify appropriate health & safety measures.	
Course Content:		
	The students will undertake a project as part of their final semester. The students can do independent projects or can take up projects in groups of two or more depending on the complexity of the project. The maximum group size will be four and in case of team projects there should be a clear delineation of the responsibilities and work done by each project member. The topic should be informed to the mentor, and the student should appear for intermediate valuations.	
Industry Internship:	Students will go for the full semester industry internship in VIIIth semester. The industry internship should duly be approved by Training & Placement department and Principal of the school. Each student will be allotted a Faculty Guide and an Industry Guide during the internship work. Students need to maintain a Project Diary and update the project progress, work reports in the project diary. Every student must submit a detailed project report as per the provided template. In the case of team projects, a single copy of these items must be submitted but each team member will be required to submit an individual report detailing their own contribution to the project. Each student/group should be allotted a supervisor and periodic internal review shall be conducted which is evaluated by panel of examiners.	
	Project Evaluation Guidelines: The Project evaluator(s) verify and validate the information presented in the project report. The break-up of marks would be as follows: 1. Internal Evaluation 2. External Assessment	
	Internal Evaluation:	

	Internal Evaluator of project needs to evaluate Internal Project work based on the following criteria: ● Project Scope , Objectives and Deliverables ● Research Work, Understanding of concepts ● Output of Results and Proper Documentation ● Interim Reports and Presentations– Twice during the course of the project ●	
	External Evaluation: The Project evaluator(s) perform the External Assessment based on the following criteria. ● Understanding of the Project Concept ● Delivery Skill ● The Final Project Report ● Originality and Novelty	
	The Final Project Report Details: ● The report should have an excel sheet that documents the work of every project member	
	Marking Scheme: 1. **Internal Evaluation:** 50% of Total Marks 2. **External Evaluation:** 50% of Total Marks **For e.g.,** if the total mark for the Internship is 300, then ❖ Internal Evaluation = 150 marks The break-up of marks is shown below:- • Interim Evaluation 1: 30 marks • Interim Evaluation 2: 30 marks • Viva Voice: 30 marks • Implementation of project : 60 marks ❖ External Evaluation = 150 marks The break-up of marks is shown below:- • Project Report: 40 marks • Explanation of project working: 50 marks Implementation / code : 60 marks	

Course Code: **IDS852**	**Specialization- Data Science** **B.Tech.- Semester-VIII** **MOOC – Professional Certification Course based on Data Science**	**L-0 T-0 P-8 C-4**
Course Outcomes:	After completion of this course students will be:	
CO1.	Understanding about online line certification.	
CO2.	Understanding to manage a work within a given time frame.	
CO3.	Applying prior acquired knowledge in problem solving.	
CO4.	Analyzing various technical problem comes during online learning.	
CO5.	Developing the technical Knowledge of new subject.	
Course Content:		
	The students will undertake a MOOC Certification as part of their final semester. Students will clear a certification decide by department or university. For smooth functioning and monitoring of the scheme the following shall be the guidelines for MOOC courses. **a)** This is recommended for every student to take at least one MOOC Course related to their domain. **b)** There shall be a MOOC co-ordination committee in the College with a faculty at the level of Professor heading the committee and all Heads of the Department being members of the Committee. **c)** After completion of MOOC course, Student will submit the photo copy of Completion certificate of MOOC Course to the Examination cell as proof. **d)** Marks will be considered which is mentioned on Completion certificate of MOOC Course.	

Course Code: **IDS 851**	**Specialization- Data Science** **B.Tech.- Semester-VIII** **Project**	**L-0** **T-0** **P-16** **C-8**
Course Outcomes:	**On successful completion of the course, students will be:-**	
CO1.	Understanding methodologies and professional way of documentation and communication.	
CO2.	Understanding about software development cycle with emphasis on different processes -requirements, design, and implementation phases.	
CO3.	Analyzing a software project and demonstrate the ability to communicate effectively in speech and writing.	
CO4.	Creating a new model over the selected field of research that will be useful for future activities.	
CO5.	Creating a project that help to gain confidence and technical knowledge.	
Course Content:	The students will undertake a project as part of their final semester. The students can do independent projects or can take up projects in groups of two or more depending on the complexity of the project. The maximum group size will be four and in case of team projects there should be a clear delineation of the responsibilities and work done by each project member. The projects must be approved by the mentor assigned to the student. The mentors will counsel the students for choosing the topic for the projects and together they will come up with the objectives and the process of the project. From there, the student takes over and works on the project. If the student chooses to undertake an industry project, then the topic should be informed to the mentor, and the student should appear for intermediate valuations. Prior to undertaking this project the students undergo a bridge course.	
Bridge Course	The bridge course ensures that all the students have the correct prerequisite knowledge before their industry interface. The purpose of a bridge course is to prepare for a healthy interaction with industry and to meet their expectations. It would be difficult to establish standards without appropriate backgrounds and therefore to bridge this gap, students are put through a week mandatory classroom participation where faculty and other experts will give adequate inputs in application based subjects, IT and soft skills.	
The Project	Each student will be allotted a Faculty Guide and an Industry Guide during the internship/project work. Students need to maintain a Project Diary and update the project progress, work reports in the project diary. Every student must submit a detailed project report as per the provided template. In the case of team projects, a single copy of these items must be submitted but each team member will be required	

	to submit an individual report detailing their own contribution to the project. Each student/group should be allotted a supervisor and periodic internal review shall be conducted which is evaluated by panel of examiners.	
Project Evaluation Guidelines	The Project evaluator(s) verify and validate the information presented in the project report. The break-up of marks would be as follows: 1. Internal Evaluation 2. External Assessment 3. Viva Voce	
External Evaluation	The Project evaluator(s) perform the External Assessment based on the following criteria. ● Understanding of the Project Concept ● Delivery Skill ● The Final Project Report ● Originality and Novelty	
The Final Project Report	● The report should have an excel sheet that documents the work of every project member	
Viva Voce	● Handling questions ● Clarity and Communication Skill	
Marking Scheme:	1. **Internal Evaluation:** 35% of Total Marks 2. **External Evaluation:** 50% of Total Marks 3. **Viva Voce:** 15 % of Total Marks **For e.g.,** if the total mark for the project is 100, then ❖ Internal Evaluation = 35 marks The break-up of marks is shown below:- ● Interim Evaluation 1: 10 marks ● Interim Evaluation 2: 10 marks ● Understanding of concepts: 5 marks ● Programming technique: 5 marks ● Execution of code : 5 marks ❖ External Evaluation = 50 marks The break-up of marks is shown below:- ● Project Report: 15 marks ● Explanation of project working: 10 marks ● Execution of code: 10 marks – (if done in industry, a stand-alone module can be reprogrammed and submitted. Error rectification etc. can be included by the evaluator) ● Participation in coding: 15 marks ❖ Viva Voce = 15 marks	

	The break-up of marks is shown below: - ● Questions related to project: 10 marks ● Questions related to technology: 5 marks The Project evaluator(s) verifies and validates the information presented in the project report.	

Course Code: IDS801	**Professional Elective Course-VII** **Specialization- Data Science** **B.Tech.- Semester-VIII** **Reinforcement Learning**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On successful completion of the course, students will be:-**	
CO1.	Understanding what constitute the main component of a Reinforcement Learning method.	
CO2.	Understanding contemporary Reinforcement learning methods.	
CO3.	Understanding sequential decision making under uncertainty.	
CO4.	Applying machine learning algorithms to solving relational and first order logical Markov decision problem.	
CO5.	Applying the reinforcement learning to solve gamming problems.	
Course Content:		
Unit-1:	**Reinforcement Learning and Markov Decision Process** Introduction- Reinforcement Learning - Examples OF Reinforcement Learning- Elements of Reinforcement Learning- Example: Tic-Tac-Toe - History of Reinforcement Learning -Learning Sequential decision Making-A Formal Frame Work on Markov Decision Process and Policies-Value Function and Bellman Equations-Solving Markov Decision Process-Dynamic Programing Model Based Solution Technique-Reinforcement Learning Model Free Solution Technique.	**8Hours**
Unit-2:	**Efficient Solution Framework** Introduction- The Batch Reinforcement Learning Problem- Foundations of Batch Reinforcement Learning Algorithms- Batch Reinforcement Learning Algorithms: Kernel-Based Approximate Dynamic Programming- Fitted Q Iteration- Least-Squares Policy Iteration- Identifying Batch Algorithms. Theory of Batch Reinforcement Learning- Neural Fitted Q Iteration (NFQ)- Batch Reinforcement Learning for Learning in Multi-agent Systems- Deep Fitted Q Iteration. Least-Squares Methods for Approximate Policy Evaluation- Least-Squares Policy Iteration- Performance Guarantees.	**8hours**
Unit-3:	**Constructive- Representational Directions** Reinforcement learning in continuous state and action space: Function Approximation- Approximate Reinforcement Learning.- Solving Relational and first-order logical Markov decision: Introduction to sequential decision in relational Reinforcement Learning- model based solution techniques- model free solution- Hierarchical Approaches- Approaches to hierarchical reinforcement learning – Evolutionary computation for Reinforcement Learning: Neuro-evolution - Hybrids- Coevolution.	**8 Hours**

Unit-4:	**Probabilistic Model For Self and Other** Bayesian Reinforcement Learning: Model free Bayesian Reinforcement Learning - Model based Bayesian Reinforcement Learning- Partially observable Markov decision process: Decision making in partially observable environments- model based techniques-Predictively defined representation of state: PSRs- Learning a PSR model- Game theory and multi agent Reinforcement Learning – Reinforcement Learning in Repeated games- Sequential games	**8 Hours**
Unit-5:	**Domain and Background** Reinforcement Learning in games- challenges of applying Reinforcement Learning to games- Reinforcement Learning in Robotics: challenges in robot REINFORCEMENT LEARNING- Foundations of Robotic Reinforcement Learning- tractability through simulation, representation and prior knowledge	**8Hours**
Text Books:	1. "Pattern Recognition And Machine Learning",. Christopher M. Bishop , Springer, 2006	
Reference Books:	1. Syntactic Pattern Recognition And Applications, Fu K.S., Prentice Hall, Eaglewood Cliffs 2. Pattern Recognition: Techniques And Applications by Rajjan Shinghal : Oxford University Press, 2008, 3. Pattern Classification and Scene Analysis, John Wiley, Duda & Hart P.E. 4. Syntactic Pattern Recognition - An Introduction by Addison Wesley Gonzalez R.C. & Thomson M.G., *** Latest editions of all the suggested books are recommended.**	
Additional electronic reference material:	1. https://web.stanford.edu/class/psych209/Readings/Sutton 2. BartoIPRLBook2ndEd.pdf	

Course Code: IDS802	**Professional Elective Course-VII** **Specialization- Data Science** **B.Tech.- Semester-VIII** **Econometrics**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On successful completion of the course, students will be:-**	
CO1.	Understanding the basic concept of economics and associated problems.	
CO2.	Understanding the concept of Indian economy.	
CO3.	Applying the appropriate engineering economics analysis, method for problem solving: present worth, annual cost, rate-of-return, payback, break-even, benefit-cost ratio.	
CO4.	Applying statistical/econometric computer package to estimate an econometric model.	
CO5.	Analyzing the cost effectiveness of multiple projects using the methods learned, and make a quantitative.	
Course Content:		
Unit-1:	**Basic Principles of Economics** Nature and Scope of Economics- Basic Economic Problems: Scarcity and choices, resource allocation, marginal analysis, opportunity costs, production possibility curve, Externalities, Welfare Economics. **Methodology of Economics** Basics of microeconomics - Demand and Supply Analysis, equilibrium, elasticity; Markets – Perfect competition, Monopoly, Monopolistic, Oligopoly. Basics of macroeconomics - the circular flow models, national income analysis (GDP/GNP/NI/Disposable Income, Green GDP), inflation trade cycles.	**8 Hours**
Unit-2:	**Public Economics** Public economics, Role of Public and private sectors in economic development, Public Expenditure and Public Debt, Monetary and Fiscal Policy Tools & their impact on the economy. **Monetary Economics** Components of Monetary and Financial System, Capital and Debt Markets, Central Bank, Commercial Banks & their functions. Price Indices (WPI/CPI), Direct and Indirect Taxes. Budget.	**8 hours**
Unit-3:	**Elements of Business and forms of organizations** Theory of the Firm: production and production function -Cost & Cost Control Techniques - Types of Costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming.	**8 Hours**
Unit-4:	**Managerial Economics and forms of organizations** Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money. Business Forecasting – Elementary techniques. Statements – Cash flow, Financial. Case Study Method.	**8 Hours**

Unit-5:	**Indian economy: Brief overview of post-independence period** 5 year plans. Industrial policy in India; Recent trends in Indian industrial growth; MNCs and transfer of technology; Liberalization and privatization; Regional industrial growth in India; Post reform Growth, Structure of productive activity.	**8 Hours**
Text Books:	1. Mankiw Gregory N.(2002), Principles of Economics, Thompson Asia	
Reference Books:	1. Pareek Saroj (2003), Textbook of Business Economics, Sunrise Publishers 2. Ahluwalia, I.J. (1985), Industrial Growth in India, Oxford University Press, New Delhi 3. V. Mote, S. Paul, G. Gupta(2004), Managerial Economics, Tata McGraw Hill 4. Misra, S.K. and Puri (2009), Indian Economy, Himalaya *** Latest editions of all the suggested books are recommended.**	
Additional electronic reference material:	1. https://www.youtube.com/watch?v=M_5SLG7sUa0&list=PLwJRxp3blEvZyQBTTOMFRP_TDaSdly3gU 2. https://www.ssc.wisc.edu/~bhansen/econometrics/Econometrics.pdf	

Course Code: **IDS803**	**Professional Elective Course-VII** **Specialization- Data Science** **B.Tech.- Semester-VIII** **Cloud for ML**	**L-3 T-0 P-0 C-3**
Course Outcomes:	**On successful completion of the course, students will be:-**	
CO1.	Understanding the different machine learning tools available in cloud.	
CO2.	Understanding the importance of simple regression in predicting new observations.	
CO3.	Understanding the concepts of K-mean clustring.	
CO4.	Applying the deep model for the new observation predictions and its importance in business.	
CO5.	Creating the clusters in AWS cloud and implement pipelining.	
Course Content:		
Unit-1:	**Introduction to Machine learning on Cloud:** Using cloud tools for ML; Feature types : Nominal, ordinal, continuous; ML project life cycle, Deploying Models.	**8Hours**
Unit-2:	**Implementing Supervised Machine Learning Algorithms on cloud** Classification Algorithms; Naïve Bayes classifier; Classifying text with language models; Understanding and evaluating regression models; understanding logistic regression; understanding random forest algorithm; understanding gradient boosting algorithm; pre-processing data, training and evaluating model.	**8hours**
Unit-3:	**Implementing Clustering Algorithms on cloud** k-means clustering : Euclidean distance, Manhattan distance; Hierarchical clustering : Agglomerative clustering, Divisive clustering; Recommendations : Collaborative filtering : Memory Based and Model Based.	**8 Hours**
Unit-4:	**Deep Learning** Understanding deep learning algorithms; Neural network algorithms : Activation functions, Backpropagation; introduction to deep neural network; understanding convolutional neural network; implementing deep learning using TensorFlow .	**8 Hours**
Unit-5:	**Optimizing and Deploying Models through AWS** Creating clusters on cloud; tuning hyperparameters; tuning clusters; creating data pipelines; managing data pipelines; deploying models ; implementation models.	**8Hours**
Text Books:	1. An Introduction to Cloud-Based Machine Learning (Addison Wesley Data & Analytics),First edition, Noah Gift.	

Reference Books:	1. Brief Guide to Cloud Computing, Christopher Barnett, Constable & Robinson Limited, 2010 2. Handbook on Cloud Computing, BorivojeFurht, Armando Escalante, Springer, 2010 *** Latest editions of all the suggested books are recommended.**	
	3. https://indico.cern.ch/event/514434/contributions/2151324/attachments/1266945/1875816/Google_ML_CERN_public.pdf 4. https://www.youtube.com/watch?v=fsv0rty7QhU	

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