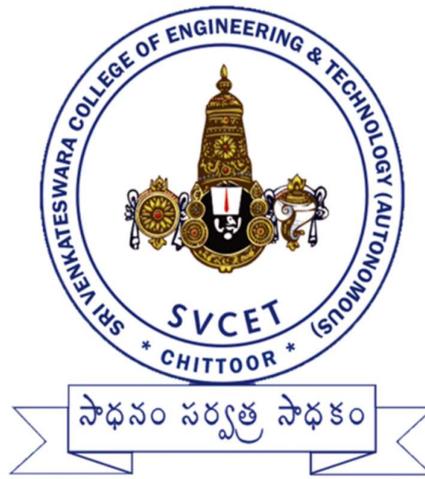# ACADEMIC REGULATIONS R-25, COURSE STRUCTURE AND DETAILED SYLLABI

M.TECH REGULAR (Full-Time) TWO YEAR DEGREE PROGRAMME
(*FOR THE BATCHES ADMITTED FROM THE ACADEMIC YEAR 2025-26*)

MASTER OF TECHNOLOGY

SRI VENKATESWARA COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS)

Accredited by NBA, New Delhi & NAAC, Bengaluru │Affiliated to JNTUA, Ananthapuramu, Recognized by the UGC under Section 12 (B) and 12 (F) │ Approved by AICTE, New Delhi.

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SRI VENKATESWARA COLLEGE OF ENGINEERING AND TECHNOLOGY
(AUTONOMOUS)
(AFFILIATED TO JNTUA, ANANTAPUR)
ACADEMIC REGULATIONS – R25
MASTER OF TECHNOLOGY (M. TECH)
REGULAR (Full-Time) TWO YEAR POST GRADUATE DEGREE PROGRAMME
(Effective for the students admitted into I year from the Academic Year
2025-26 and onwards)

Sri Venkateswara College of Engineering and Technology (Autonomous), offers **Two** Years (Four Semesters) full-time Master of Technology (M.Tech.) Degree programme, under Choice Based Credit System (CBCS) in different branches of Engineering and Technology with different specializations.

The Jawaharlal Nehru Technological University Anantapur, Ananthapuramu shall confer M.Tech Post Graduate degree to candidates who are admitted to the Master of Technology Program and fulfill all the requirements for the award of the degree.

1. **Applicability** :
   All the rules specified herein, approved by the Academic Council, shall be in the force and applicable to the students admitted from the Academic Year 2020-2021 onwards. Any reference to "College" in these rules and regulations stands for SVCET.

2. **Extent**: All the rules and regulations, specified hereinafter shall be read as a whole for the purpose of interpretation. As and when a doubt arises, the interpretation of the Chairman, Academic Council shall be final and ratified by the Academic Council in the forthcoming meeting. As per the requirements of statutory bodies, Principal, Sri Venkateswara College of Engineering College shall be the Chairman, Academic Council.

3. **Award of the M.Tech. Degree**
   A student will be declared eligible for the award of the M.Tech. degree if he/ she fulfils the following:
   3.1 Pursues a course of study for not less than two academic years and not more than four academic years.
   3.2 Registers for 70 credits and secures all 70 credits.

4. Students, who fail to fulfil all the academic requirements for the award of the degree within four academic years from the year of their admission, shall forfeit their seat in M.Tech. course and their admission stands cancelled.

5. **Programme of Study:**
   The following M.Tech. Specializations are offered at present in different branches of Engineering and Technology in the institution:

Sl. No.	Discipline	Name of the Specialization	Code
01	Civil Engineering	Structural Engineering	20
02	Electrical and	Power Electronics & Electrical	54

	Electronics Engineering	Drives	
03	Mechanical Engineering	CAD / CAM	04
04	Electronics and Communication Engineering	VLSI Design	57
05	Computer Science and Engineering	Computer Science & Engineering	58
06		Data Science	32

and any other specializations as approved by AICTE/University from time to time.

6 Eligibility for Admissions:

6.1 Admission to the M. Tech Program shall be made subject to the eligibility, qualification and specialization prescribed by the A.P. State Government/University from time to time.

6.2 Admissions shall be made either on the basis of either the merit rank or Percentile obtained by the qualified student in the relevant qualifying GATE Examination/ the merit rank obtained by the qualified student in an entrance test conducted by A.P. State Government (APPGECET) for M.Tech. programmes/an entrance test conducted by University/on the basis of any other exams approved by the University, subject to reservations as laid down by the Govt. from time to time.

7 Programme related terms:

7.1 *Credit:* A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (Lecture/Tutorial) or two hours of practical work/field work per week.

Credit definition:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 credit

7.2 *Academic Year:* Two consecutive (one odd + one even) semesters constitute one academic year.

7.3 *Choice Based Credit System (CBCS):* The CBCS provides choice for students to select from the prescribed courses.

8 Programme Pattern:

8.1 Total duration of the of M.Tech. programme is two academic years

8.2 Each academic year of study is divided into two semesters.

8.3 Each Semester shall be of 22 weeks duration (inclusive of Examinations), with a minimum of 90 instructional days per semester.

8.4 The student shall not take more than four academic years to fulfill all the academic requirements for the award of M.Tech. degree from the date of commencement of first year first semester, failing which the student shall forfeit the seat in M.Tech. programme.

8.5 The medium of instruction of the programme (including examinations and

project reports) will be in English only.

8.6 All subjects/courses offered for the M.Tech. degree programme are broadly classified as follows:

S. No.	Broad Course Classification	Course Category	Description
1.	Core Courses	Foundational & Professional Core Courses (PC)	Includes subjects related to the parent discipline / department / branch of Engineering
2.	Elective Courses	Professional Elective Courses (PE)	Includes elective subjects related to the parent discipline/ department/ branch of Engineering
		Open Elective Courses (OE)	Elective subjects which include inter-disciplinary subjects or subjects in an area outside the parent discipline which are of importance in the context of special skill development
3.	Research	Research methodology & IPR	To understand importance and process of creation of patents through research
		Technical Seminar	Ensures preparedness of students to undertake major projects / Dissertation, based on core contents related to specialization
		Cocurricular Activities	Attending conferences, scientific presentations and other scholarly activities
		Dissertation	M.Tech. Project or Major Project
4.	Audit Courses	Mandatory noncredit courses	Covering subjects of developing desired attitude among the learners is on the line of initiatives such as Unnat Bharat Abhiyan, Yoga, Value education etc.

8.7 The college shall take measures to implement Virtual Labs (https://www.vlab.co.in) which provide remote access to labs in various disciplines of Engineering and will help student in learning basic and advanced concept through remote experimentation. Student shall be made to work on virtual lab experiments during the regular labs.

8.8 A faculty advisor/mentor shall be assigned to each specialization to advise students on the programme, its Course Structure and Curriculum, Choice of Courses, based on his competence, progress, pre-requisites and interest.

8.9 Preferably 25% course work for the theory courses in every semester shall be conducted in the blended mode of learning.

9 Attendance Requirements:

9.1 A student shall be eligible to appear for the external examinations if he/she acquires i) a minimum of 50% attendance in each course and ii) 75% of attendance in aggregate of all the courses.

9.2 Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee.

9.3 Condonation of shortage of attendance shall be granted only on genuine and valid reasons on representation by the candidate with supporting evidence

9.4 Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examination of that class.

9.5 A stipulated fee shall be payable towards condonation of shortage of attendance.

9.6 A student will not be promoted to the next semester unless he satisfies the attendance requirements of the present semester. They may seek re-admission into that semester when offered next.

9.7 If any candidate fulfils the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

9.8 If the learning is carried out in blended mode (both offline & online), then the total attendance of the student shall be calculated considering the offline and online attendance of the student.

10 Evaluation – Distribution and Weightage of Marks:

The performance of a student in each semester shall be evaluated subject - wise (irrespective of credits assigned), for a maximum of 100 marks for theory and 100 marks forpractical, based on Internal Evaluation and End Semester Examination.

10.1 There shall be five units in each of the theory subjects. For the theory subjects 60 marks will be for the End Examination and 40 marks will be for Internal Evaluation.

10.2 Two Internal Examinations shall be conducted for 30 marks each, one in the middle of the Semester and the other immediately after the completion of instruction. First mid examination shall be conducted for I & II units of the syllabus and second mid examination for III, IV & V units. Each mid exam shall be conducted for a total duration of 120 minutes with 3 questions (without choice) each question for 10 marks. Final Internal marks for a total of 30 marks shall be arrived at by considering the marks secured by the student in both the internal examinations with 80% weightage to the better internal exam and 20% to the other. There shall be an online examination (TWO) conducted during the respective mid examinations by the college for the remaining 10 marks with 20 objective questions.

10.3 The following pattern shall be followed in the End Examination:

10.3.1 Five questions shall be set from each of the five units with either/or type for 12 marks each.

10.3.2 All the questions have to be answered compulsorily.

10.3.3 Each question may consist of one, two or more bits.

10.4 For practical subjects, 60 marks shall be for the End Semester Examinations and 40 marks will be for internal evaluation based on the day-to-day performance.

The internal evaluation based on the day-to-day work-10 marks, record-10 marks and the remaining 20 marks to be awarded by conducting an internal laboratory test. The end examination shall be conducted by the examiners, with a breakup mark of Procedure-10, Experimentation-25, Results-10, Viva- voce-15.

10.5 There shall be a **Technical Seminar** during I year II semester for internal evaluation of 100 marks. A student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Project Review Committee consisting of Head of the Department, supervisor/mentor and two other faculty members of the department. The student has to secure a minimum of 50% of marks, to be declared successful. If he fails to obtain the minimum marks, he has to reappear for the same as and when supplementary examinations are conducted. The Technical seminar shall be conducted anytime during the semester as per the convenience of the Project Review Committee and students. There shall be no external examination for Technical Seminar.

10.6 There shall be Mandatory **Audit courses** in I & II semesters for zero credits. There is no external examination for audit courses. However, attendance shall be considered while calculating aggregate attendance and student shall be declared to have passed the mandatory course only when he/she secures 50% or more in the internal examinations. In case, the student fails, a re- examination shall be conducted for failed candidates for 40 marks every six months/semester satisfying the conditions mentioned in item 1 & 2 of the regulations.

10.7 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.

10.8 In case the candidate does not secure the minimum academic requirement in any of the subjects he/she has to reappear for the Semester Examination either supplementary or regular in that subject or repeat the course when next offered or do any other specified subject as may be required.

10.9 The laboratory records and mid semester test papers shall be preserved for a minimum of 3 years in the respective institutions as per the University norms and shall be produced to the Committees of the University as and when the same are asked for.

11   Credit Transfer Policy

As per University Grants Commission (Credit Framework for Online Learning Courses through SWAYAM) Regulation, 2016, the Institution shall allow up to a maximum of 40% of the total courses being offered in a particular Programme in a semester through the Online Learning courses through SWAYAM.

11.1 The Institution shall offer credit mobility for MOOCs and give the equivalent credit weightage to the students for the credits earned through online learning courses through SWAYAM platform.

11.2 The online learning courses available on the SWAYAM platform will be considered for credit transfer. SWAYAM course credits are as specified in the platform

11.3 Student registration for the MOOCs shall be only through the institution, it is mandatory for the student to share necessary information with the institution

11.4 The institution shall select the courses to be permitted for credit transfer through SWAYAM. However, while selecting courses in the online platform institution would essentially avoid the courses offered through the curriculum in the offline mode.

11.5 The institution shall notify at the beginning of semester the list of the online learning courses eligible for credit transfer in the forthcoming Semester.

11.6 The institution shall also ensure that the student has to complete the course and produce the course completion certificate as per the academic schedule given for the regular courses in that semester

11.7 The institution shall designate a faculty member as a Mentor for each course to guide the students from registration till completion of the credit course.

11.8 The Institution shall ensure no overlap of SWAYAM MOOC exams with that of the Internal / External examination schedule. In case of delay in SWAYAM results, the Institution will re-issue the marks sheet for such students.

11.9 Student pursuing courses under MOOCs shall acquire the required credits only after successful completion of the course and submitting a certificate issued by the competent authority along with the percentage of marks and grades.

11.10 The departments shall submit the following to the examination section of the Institution:
   a) List of students who have passed MOOC courses in the current semester along with the certificates of completion.
   b) Undertaking form filled by the students for credit transfer.

11.11 The Institution shall resolve any issues that may arise in the implementation of this policy from time to time and shall review its credit transfer policy in the light of periodic changes brought by UGC, SWAYAM, NPTEL and state government.

Note: Students shall also be permitted to register for MOOCs offered through online platforms other than SWAYAM NPTEL. In such cases, credit transfer shall be permitted only after seeking approval of the Head of the Institution at least three months prior to the commencement of the semester.

12 Re-registration for Improvement of Internal Evaluation Marks:
   A candidate shall be given one chance to re-register for each subject provided the internal marks secured by a candidate are less than 50% and has failed in the end examination

12.1 The candidate should have completed the course work and obtained examinations results for **I, II and III** semesters.

12.2 The candidate should have passed all the subjects for which the Internal Evaluation marks secured are more than 50%.

12.3 Out of the subjects the candidate has failed in the examination due to Internal Evaluation marks secured being less than 50%, the candidate shall be given one chance for each Theory subject and for a maximum of **three** Theory subjects for Improvement of Internal evaluation marks.

12.4 The candidate has to re-register for the chosen subjects and fulfill the academic requirements.

12.5 For reregistration the candidates have to submit the applications to the Head of the Institution through the Head of the Department by paying the requisite fees (For each course, the candidate has to pay a fee equivalent to one third of the semester tuition fee and the amount is to be remitted in the form of D.D./ Challan in favour of the Principal, Sri Venkateswara College of Engineering & Technology) and get approval from the Head of the Institution before the start of the semester in which re-registration is required.

12.6 In the event of availing the Improvement of Internal evaluation marks, the internal evaluation marks as well as the End Examinations marks secured in the previous attempt(s) for the reregistered subjects stand cancelled.

13 Evaluation of Project/Dissertation Work:

The Project work shall be initiated at the beginning of the III Semester and the duration of the Project is of two semesters. Evaluation of Project work is for 300 marks with 200 marks for internal evaluation and 100 marks for external evaluation. Internal evaluation of the Project Work – I & Project work – II in III & IV semesters respectively shall be for 100 marks each. External evaluation of final Project work viva voce in IV semester shall be for 100 marks.

A Project Review Committee (PRC) shall be constituted with the Head of the Department as Chairperson, Project Supervisor and one faculty member of the department offering the M.Tech. programme.

13.1 A candidate is permitted to register for the Project Work in III Semester after satisfying the attendance requirement in all the subjects, both theory and laboratory (in I & II semesters).

13.2 A candidate is permitted to submit Project dissertation with the approval of PRC. The candidate has to pass all the theory, practical and other courses before submission of the Thesis.

13.3 Project work shall be carried out under the supervision of teacher in the parent department concerned.

13.4 A candidate shall be permitted to work on the project in an industry/research organization on the recommendation of the Head of the Department. In such cases,one of the teachers from the department concerned would be the internal guide and an expert from the industry/ research organization concerned shall act as co-supervisor/ external guide. It is mandatory for the candidate to make full disclosure of all

data/results on which they wish to base their dissertation. They cannot claim confidentiality simply because it would come into conflict with the Industry's or R&D laboratory's own interests. A certificate from the external supervisor is to be included in the dissertation.

13.5 Continuous assessment of Project Work - I and Project Work – II in III & IV semesters respectively will be monitored by the PRC.

13.6 The candidate shall submit status report by giving seminars in three different phases (two in III semester and one in IV semester) during the project work period. These seminar reports must be approved by the PRC before submission of the Project Thesis.

13.7 After registration, a candidate must present in Project Work Review - I, in consultation with his Project Supervisor, the title, objective and plan of action of his Project work to the PRC for approval within four weeks from the commencement of III Semester. Only after obtaining the approval of the PRC can the student initiate the project work.

13.8 The Project Work Review - II in III semester carries internal marks of 100. Evaluation should be done by the PRC for 50 marks and the Supervisor will evaluate the work for the other 50 marks. The Supervisor and PRC will examine the Problem Definition, Objectives, Scope of Work, Literature Survey in the same domain and progress of the Project Work.

13.9 A candidate has to secure a minimum of 50% of marks to be declared successful in Project Work Review - II. Only after successful completion of Project Work Review – II, candidate shall be permitted for Project Work Review – III in IV Semester. The unsuccessful students in Project Work Review - II shall reappear for it as and when supplementary examinations are conducted.

13.10 The Project Work Review - III in IV semester carries 100 internal marks. Evaluation should be done by the PRC for 50 marks and the Supervisor will evaluate it for the other 50 marks. The PRC will examine the overall progress of the Project Work and decide whether or not eligible for final submission. A candidate has to secure a minimum of 50% of marks to be declared successful in Project Work Review - III. If he fails to obtain the required minimum marks, he has to reappear for Project Work Review - III after a month.

13.11 For the approval of PRC the candidate shall submit the draft copy of dissertation to the Head of the Department and make an oral presentation before the PRC.

13.12 After approval from the PRC, the students are required to submit a report showing that the plagiarism is within 30%. The dissertation report will be accepted only when the plagiarism is within 30%, which shall be submitted along with the dissertation report.

13.13 Research paper related to the Project Work shall be published in conference proceedings/UGC recognized journal. A copy of the published research paper shall be attached to the dissertation.

13.14 After successful plagiarism check and publication of research paper, three copies of the dissertation certified by the supervisor and HOD shall be submitted to the College.

13.15 The dissertation shall be adjudicated by an external examiner selected by the Head of the Institution. For this, the Principal of the College shall

submit a panel of three examiners as submitted by the supervisor concerned and department head for each student. However, the dissertation will be adjudicated by one examiner nominated by the Head of the Institution.

13.16 If the report of the examiner is not satisfactory, the candidate shall revise and resubmit the dissertation, in the time frame as decided by the PRC. If report of the examiner is unfavorable again, the thesis shall be summarily rejected. The candidate has to reregister for the project and complete the project within the stipulated time after taking the approval from the Head of the Institution

13.17 If the report of the examiner is satisfactory, the Head of the Department shall coordinate and make arrangements for the conduct of Project Viva voce exam.

13.18 The Project Viva voce examinations shall be conducted by a board consisting of the Supervisor, Head of the Department and the external examiner who has adjudicated the dissertation. For Dissertation Evaluation (Viva voce) in IV Sem. there are external marks of 100 and it is evaluated by external examiner. The candidate has to secure a minimum of 50% marks in Viva voce exam.

13.19 If he fails to fulfill the requirements as specified, he will reappear for the Project Viva voce examination only after three months. In the reappeared examination also, if he fails to fulfill the requirements, he will not be eligible for the award of the degree.

14 Credits for Co-curricular Activities

The credits assigned for co-curricular activities shall be given by the Head of the Department and the same shall be submitted to the Examination section through Head of the Institution.

A Student shall earn 02 credits under the head of co-curricular activities, viz., attending Conference, Scientific Presentations and Other Scholarly Activities.

Following are the guidelines for awarding Credits for Co-curricular Activities

Name of the Activity	Maximum Credits / Activity
Participation in National Level Seminar/ Conference / Workshop /Training programs (related to the specialization of the student)	1
Participation in International Level Seminar / Conference / workshop/Training programs held outside India (related to the specialization of the student)	2
Academic Award/Research Award from State Level/National Agencies	1
Academic Award/Research Award from International Agencies	2
Research / Review Publication in National Journals (Indexed in Scopus / Web of Science)	1

Research / Review Publication in International Journals with Editorial board outside India (Indexed in Scopus / Web of Science)	2

Note:
i) Credit shall be awarded only for the first author. Certificate of attendance and participation in a Conference/Seminar is to be submitted for awarding credit.
ii) Certificate of attendance and participation in workshops and training programs (Internal or External) is to be submitted for awarding credit. The total duration should be at least one week.
iii) Participation in any activity shall be permitted only once for acquiring required credits under cocurricular activities

15 Grading:

As a measure of the student's performance, a 10-point Absolute Grading System using the following Letter Grades and corresponding percentage of marks shall be followed:

After each course is evaluated for 100 marks, the marks obtained in each course will be converted to a corresponding letter grade as given below, depending on the range in which the marks obtained by the student fall.

Structure of Grading of Academic Performance

Range in which the marks in the subject fall	Grade	Grade points Assigned
≥ 90	S (Superior)	10
≥ 80 < 90	A (Excellent)	9
≥ 70 < 80	B (Very Good)	8
≥ 60 < 70	C (Good)	7
≥ 50 < 60	D (Pass)	6
< 50	F (Fail)	0
Absent	Ab (Absent)	0

i) A student obtaining Grade 'F' or Grade 'Ab' in a subject shall be considered failed and will be required to reappear for that subject when it is offered the next supplementary examination.
ii) For noncredit audit courses, "Satisfactory" or "Unsatisfactory" shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA/Percentage.

Computation of Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):
The Semester Grade Point Average (SGPA) is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.,

$$SGPA = \Sigma (C_i \times G_i)/\Sigma C_i$$

where, C_i is the number of credits of the ith subject and G_i is the grade point scored by the student in the ith course.

i) The Cumulative Grade Point Average (CGPA) will be computed in the same manner considering all the courses undergone by a student over all the semesters of a program, i.e.,
$$CGPA = \Sigma\ (C_i \times S_i)/\ \Sigma\ C_i$$
where "S_i" is the SGPA of the ith semester and C_i is the total number of credits up to that semester.

ii) Both SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

iii) While computing the SGPA the subjects in which the student is awarded Zero grade points will also be included.

Grade Point: It is a numerical weight allotted to each letter grade on a 10-point scale. Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by letters S, A, B, C, D and F.

16 Personal Verification / Revaluation / Final Valuation
16.1 Personal Verification of Answer Scripts:
Candidates appear in a particular semester end examinations may appeal for verification of their answer script(s) for arithmetic correction in totaling of marks and any omission / deletion in evaluation within 7 days from the date of declaration of results at the office of the Controller of Examinations on the prescribed proforma and by paying the prescribed fee per answer script.

It is clarified that personal verification of answer script shall not tantamount to revaluation of answer script. This is only a process of reverification by the candidate. Any mistake / deficiency with regard to arithmetic correction in totaling of marks and any omission / deletion in evaluation if found, the institution will correct the same.

16.2 Recounting / Revaluation:
Students shall be permitted for request for recounting/revaluation of the Semester-End examination answer scripts within a stipulated period after payment of prescribed fee. After recounting or revaluation, records are updated with changes if any and the student will be issued a revised grade sheet. If there are no changes, the same will be intimated to the students.

16.3 Final Valuation:
Students shall be permitted for request for final valuation of the Semester–End Examination answer scripts within a stipulated period after the publication of the revaluation results by paying the necessary fee. The final valuation shall be carried out by an expert not less than Associate Professor as per the scheme of valuation supplied by the examination branch in the presence of the student, Controller of Examinations and Principal. However students are not permitted to discuss / argue with the examiner. If the increase in marks after final valuation is equal to or more than 15% of the

previous valuation marks, the marks obtained after final valuation shall be treated as final. If the variation of marks after final valuation is less than 15% of the previous valuation marks, then the earlier valuation marks shall be treated as the final marks.

Supplementary Examinations: In addition to the regular semester-end examinations conducted, the College may also schedule and conduct supplementary examinations for all the courses of other semesters when feasible for the benefit of students. Such of the candidates writing supplementary examinations may have to write more than one examination per day.

17 Award of Class:

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree, he shall be placed in one of the following three classes:

Class Awarded	Cumulative Grade Point Average
First Class with Distinction	≥7.75
First Class	≥6.75 and<7.75
Second Class	≥6.0 and <6.75

18 Exit Policy:

The student shall be permitted to exit with a PG Diploma based on his/her request to the Head of the Institution through the respective Head of the Department at the end of first year subject to passing all the courses in first year.

The Head of the Institution shall resolve any issues that may arise in the implementation of this policy from time to time and shall review the policy in the light of periodic changes brought by UGC, AICTE, Affiliating University and State government.

19 Withholding of Results:

If the candidate has any case of in-discipline pending against him, the result of the candidate shall be withheld, and he will not be allowed/promoted into the next higher semester. The issue of degree is liable to be withheld in such cases.

20. Transitory Regulations

Discontinued, detained, or failed candidates are eligible for readmission as and when the semester is offered after fulfilment of academic regulations. Candidates who have been detained for want of attendance or not fulfilled academic requirements or who have failed after having undergone the course in earlier regulations or have discontinued and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent subjects as and when subjects are offered, subject to Section 2 and they will follow the academic regulations into which they are readmitted.

21. Medium of Instruction:

The Medium of Instruction is English for all courses, laboratories, Internal and External examinations, Seminar Presentation and Project Reports.

22. Mode of Learning:

Preferably 50% course work for the theory courses in every semester shall be conducted in the blended mode of learning. If the blended learning is carried out in online mode, then the total attendance of the student shall be calculated considering the offline and online attendance of the student.

23. General Instructions:

23.1 The academic regulations should be read as a whole for purpose of any interpretation.

23.2 Disciplinary action for Malpractice/improper conduct in examinations is appended.

23.3 There shall be no places transfer within the constituent colleges and affiliated colleges of Jawaharlal Nehru Technological University Anantapur.

23.4 Where the words "he", "him", "his", occur in the regulations, they include "she", "her", "hers".

23.5 In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal is final.

23.6 The University / Institution may change or amend the academic regulations or syllabi at any time and the changes or amendments shall be made applicable to all the students on rolls with effect from the dates notified by the University / Institution.

23.7 The above rules and regulations are to be approved / ratified by the College Academic Council as and when any modification is to be done.

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Identification of Courses

M. Tech

Each course shall be uniquely identified by an alphanumeric code of width 7 characters as given below.

No. of Digits	Description
First two digits	Year of regulations Ex:25
Next one letter	Type of program: A: B. Tech B: M. Tech C: M.B.A D: M.C.A E: BBA F: BCA
Next two letters	Code of program: ST: Structural Engineering, P.E: Power Electronics & Electric Drives, CM: CAD/CAM, VL: VLSI, CS: Computer Science and Engineering, DS: Data Science
Last two digits	Indicate serial numbers: ≥ 01

Ex:
25BST01
25BPE01
25BCM01
25BVL01
25BCS01
25BDS01
25BMB01
25BHS01

SRI VENKATESWARA COLLEGE OF ENGINEERING AND TECHNOLOGY
(AUTONOMOUS)
(AFFILIATED TO JNTUA, ANANTHAPURAMU)
RULES FOR DISCIPLINARY ACTION FOR MALPRACTICE / IMPROPER CONDUCT IN EXAMINATIONS

Sl.No.	Nature of Malpractices / Improper conduct If the candidate	Punishment
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination).	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester / year. The Hall Ticket of the candidate is to be cancelled.
3.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and

		project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester / year.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that Semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that Semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
6.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that Semester/year. The candidate is also debarred and forfeits of seat.
7.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and

		forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practical's and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the impostor is an outsider, he will be handed over to the police and a case is registered against him.
8.	Refuses to obey the orders of the Chief Superintendent / Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in-charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction or property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate (s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester / year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.

	means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester / year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the Examination committee for further action to award suitable punishment.	

Malpractices identified by squad or special invigilators
  1. Punishments to the candidates as per the above guidelines.

Note:
Whenever the performance of a student is cancelled in any subject/subjects due to Malpractice, he has to register for End Examinations in that subject/subjects consequently and has to fulfil all the norms required for the award of Degree.

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DEPARTMENT OF
COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)

VISION

- Evolve as center of Excellence in computer science and Engineering education with national and international reputation and adapt itself to the rapid advancements in the computer Science and Engineering Field.

MISSION

- To impart high quality professionals in undergraduate and postgraduate level with emphasis on basic principles of computer Science and Engineering and to foster leading edge research in the fast changing field.
- To inculcate professional behavior, strong ethical values, innovative research capabilities and leadership abilities in the young minds so as to work with a commitment to the progress of the nation

DEPARTMENT OF
COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)

ROGRAMME EDUCATIONAL OBJECTIVES

- **PEO1:** Graduates of the program will be employed in industry, government and entrepreneurial endeavors to have a successful professional career.

- **PEO2:** To engage in sustainable development and demonstrate data analysis skills for effective interpretation and decision making to solve real life problems.

- **PEO3:** To be able to adapt to the evolving technical challenges and changing career opportunities. Learn to effectively communicate ideas in oral, written, or graphical form to promote collaboration other engineering teams in accordance with social standards and ethical practices.

PROGRAMME SPECIFIC OUTCOMES

- **PSO1:** Understand the various processes involved in application development in the Context of data science.

- **PSO2:** Develop realistic solutions to meet the requirements of the society and the industry using the acquired data analytics skills.

DEPARTMENT OF
COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)

PROGRAM OUTCOMES

PO1   To obtain sound knowledge in the theory, principles and applications of computer systems.

PO2   Having an ability to apply mathematics and science in engineering applications.

PO3   Configure recent software tools, apply test conditions, and deploy and manage them on comput

PO4   Having an ability to design and conduct experiments, as well as to analyze and interpret data, and synthesis of information.

PO5   Having an ability to use techniques, skills, resources and modern engineering and IT tools necessary for engineering practice

PO6   Identify, formulate and solve software engineering problems and understand the software project management principles.

PO7   nderstand the computing needs of inter-disciplinary scientific and engineering disciplines and develop algorithms and techniques for achieving these.

PO8   Communicate effectively in oral, written and graphical form to extend entrepreneurship and leadership skills.

PO9   Ability to extend the state of art in some of the areas of interest and create new knowledge.

PO10   Having problem solving ability- to assess social issues (societal, health, safety, legal and cultural) and engineering problems

PO11   Toidentifytheshortcomingsandexaminetheoutcomesofone'sactionwithout depending on external feedback and implement the corrective measures subsequently to develop their career.

SRI VENKATESWARA COLLEGE OF ENGINEERING & TECHNOLOGY
(AUTONOMOUS)
R.V.S. NAGAR, CHITTOOR - 517127, A.P.

COURSE STRUCTURE AND SCHEME OF EXAMINATION
FOR M.TECH. - COMPUTER SCIENCE AND ENGINEERING (DATA SCIENCE)

M.TECH. I - SEMESTER

S. No.	Course code	Course Name	Category	L	T	P	Credits	CIE	SEE	TOTAL
1	25BHS07	Mathematical Foundations for Data Science	PC	3	0	0	3	40	60	100
2	25BDS01	Data Science with Python	PC	3	0	0	3	40	60	100
PROGRAM ELECTIVE COURSE – I										
3	25BDS02	Machine Learning Techniques	PE	3	0	0	3	40	60	100
	25BDS03	Data Engineering Principles for Enterprises								
	25BDS04	Big Data Mining								
PROGRAM ELECTIVE COURSE – II										
4	25BDS05	Data Preparation and Analysis	PE	3	0	0	3	40	60	100
	25BDS06	SQL and NoSQL for Data Science								
	25BDS07	Web and Text Analytics								
5	25BDS08	Data Preparation and Analysis Lab	PC	0	0	4	2	40	60	100
6	25BDS09	Machine Learning Techniques Lab	PC	0	0	4	2	40	60	100
7	25BMB01	Research Methodology and IPR	MC	2	0	0	2	40	60	100
AUDIT COURSE - I										
8	25BHS02	English for Research Paper Writing	AC	2	0	0	-	-	-	-
	25BST27	Disaster Management								
	25BHS03	Sanskrit for Technical Knowledge								
		TOTAL		**16**	**0**	**8**	**18**	**280**	**420**	**700**

M.TECH. II – SEMESTER

S. No.	Course code	Course Name	Category	Hours per week			Credits	Scheme of Examination (Maximum Marks)		
				L	T	P		CIE	SEE	TOTAL
1	25BDS10	Data Analytics	PC	3	0	0	3	40	60	100
2	25BDS11	Big Data Frameworks and Technologies	PC	3	0	0	3	40	60	100
PROGRAM ELECTIVE COURSE – III										
3	25BDS12	Multivariate Techniques for Data Analysis	PE	3	0	0	3	40	60	100
	25BDS13	Security for Data Engineering								
	25BDS14	Statistical Machine Learning								
PROGRAM ELECTIVE COURSE – IV										
4	25BDS15	Data Storage Technologies and Networks	PE	3	0	0	3	40	60	100
	25BDS16	Advanced Data Visualization								
	25BDS17	Artificial Intelligence and Deep Learning								
5	25BDS18	Advanced Data Analytics Lab	PC	0	0	4	2	40	60	100
6	25BDS19	Big Data Frameworks and Technologies Lab	PC	0	0	4	2	40	60	100
7	25BDS20	Technical seminar	PR	0	0	4	2	40	60	100
AUDIT COURSE - II										
8	25BMB03	Pedagogy Studies	AC	2	0	0	-	-	-	-
	25BHS04	Stress Management by Yoga								
	25BHS05	Personality Development through Life Enlightenment Skills								
		TOTAL		**14**	**0**	**12**	**18**	**280**	**480**	**700**

M.TECH. III - SEMESTER

S. No.	Course code	Course Name	Category	L	T	P	Credits	CIE	SEE	TOTAL
				Hours per week				Scheme of Examination (Maximum Marks)		

S. No.	Course code	Course Name	Category	Hours per week L	T	P	Credits	CIE	SEE	TOTAL
PROGRAM ELECTIVE COURSE – V										
1	25BDS21	Data Science in Bioinformatics	PE	3	0	0	3	40	60	100
	25BDS22	Reinforcement Learning								
	25BDS23	Data Science for Decision Making								
OPEN ELECTIVE										
2	25BCM28	Waste to Energy	OE	3	0	0	3	40	60	100
	25BMB04	Business Analytics								
	25BDS24	Cyber Security								
3	25BDS25	**DISSERTATION PHASE-I**	PR	-	-	20	**10**	40	60	100
4	25BDS26	Co-curricular Activities					**2**			
		TOTAL		**6**	**0**	**20**	**18**	**120**	**180**	**300**

M.TECH. IV-SEMESTER

S. No.	Course code	Course Name	Category	L	T	P	Credits	CIE	SEE	TOTAL
1	25BDS27	**DISSERTATION PHASE - II**	PR	**0**	**0**	**32**	**16**	**120**	**180**	**300**
		TOTAL		**0**	**0**	**32**	**16**	**120**	**180**	**300**

Sri Venkateswara College of Engineering and Technology
(Autonomous)

M.Tech. - I Semester CSE(DS)

25BHS07	MATHEMATICAL FOUNDATIONS FOR DATA SCIENCE	L	T	P	C
		3	0	0	3

Course Objectives:

The objectives of this course are to

- Introduce the students to the fundamental concepts and techniques of linear algebra to develop both computational skills and theoretical understanding.
- understand probability, sampling and graph theory that serve as an essential tool for applications of computer and information sciences.
- Understand the foundations of Bayesian inference, build and interpret Bayesian models.
- Understand the principles and assumptions underlying non-parametric statistical methods and apply rank-based methods
- To apply multivariate techniques, conduct classification and discrimination analysis.

UNIT - I   Linear Algebra   9 Hours

Systems of Linear Equations - Machine learning motivation - A geometric notion of singularity - Singular vs non-singular matrices - Linear dependence and independence - Matrix row -reduction - Row operations that preserve singularity - The rank of a matrix - Row echelon form - Reduced row echelon form - LU decomposition- Solving Systems of Linear Equations - Machine learning motivation - Solving non- singular systems of linear equations - Solving singular systems of linear equations - Solving systems of equations with more variables - Gaussian elimination.

UNIT - II   Probability & Statistics   10 Hours

Introduction to probability - Concept of probability: repeated random trials - Conditional probability and independence - Random variables - Cumulative distribution function - Discrete random variables: Binomial distribution - Probability mass function - Continuous random variables: Uniform distribution - Continuous random variables: Gaussian distribution -Joint distributions - Marginal and conditional distributions - Independence - covariance - Multivariate normal distribution - Sampling and point estimates - Interval estimation - Confidence intervals – Confidence Interval for mean of population - Biased vs Unbiased estimates-Maximum likelihood estimation - Intuition behind maximum likelihood estimation - Hypothesis testing - Describing samples: sample proportion and sample mean - Two types of errors - Test for proportion and means - Two sample inference for difference between groups.

UNIT - III   Bayesian Statistics & its applications in various fields   9 Hours

Bayesian statistics and its applications in various fields - Bayesian Learning: Bayes theorem - maximum likelihood and least squared error hypotheses – Naïve Bayes classifier- Bayesian belief networks- gradient ascent training of Bayesian networks- learning the structure of Bayesian networks- the EM algorithm- mixture of models- Markov models- hidden Markov models - Time series analysis and forecasting techniques - Basic Properties of time-series data: Distribution and moments- Stationarity- Autocorrelation- Heteroscedasticity- Normality- Survival Analysis.

UNIT - IV   Non-Parametric Statistics   9 Hours

Non-parametric Statistics - Chi square test- Sign test - Wilcoxon signed rank test - Mann Whitney test - Run test - Kolmogorov Smirnov test - Spearmann and Kendall's test - Tolerance region.

UNIT - V   Multivariate Statistical Methods for Analyzing Complex Datasets   9 Hours

Multivariate statistical methods for analysing complex datasets - Factor Analysis - Cluster Analysis- Regression Analysis - Discriminant Analysis.

Course Outcomes:

Students will be able to refresh the statistical knowledge learnt earlier with hands-on practical expertise.

- Apply linear algebra techniques to model and solve complex problems in diverse domains.
- Demonstrate proficiency with statistical analysis of data and to apply data science concepts and methods to solve problems in real-world contexts.
- Model Bayesian forecasting techniques to time series data and other predictive modeling tasks.
- Understands and apply various non-parametric statistics techniques
- Formulate, test and interpret various nonparametric tests for solving various statistical problems.

Reference Books:

1. James D. Miller, Statistics for Data Science, Packt Publishing, 2017
2. IND James D. Hamilton, Time Series Analysis, Levant Books, 2012
3. Bayesian statistics and its applications in various fields: Indian Institute of Technology Roorkee/Mehta Family School of Data Science and Artificial Intelligence/Course Title: Machine Learning.
4. Indian Institute of Technology Roorkee/Mehta Family School of Data Science and Artificial Intelligence/Course Title: Time Series Data Analysis.
5. M.R Anderberg, M.R. Anderberg, "Cluster Analysis for Applications", Academic Press

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2					2						2
CO2	3		1				2						2
CO3												1	
CO4													2
CO5												1	

3- High mapping   **2-Medium Mapping**   **1- Low Mapping**

Sri Venkateswara College of Engineering and Technology
(Autonomous)

M.Tech. - I Semester CSE(DS)

25BDS01	DATA SCIENCE WITH PYTHON	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand the basics of Python and standard modules used for data science with hands-on.
- Understand the data structures and visualization used for data science with hands-on.
- Understand the machine learning libraries used for data science with hands-on.
- Gain an understanding of essential machine learning algorithms and techniques using the Scikit-Learn library, and apply them to real-world data science problems
- Apply Python programming and data science techniques to practical problems and projects, including data preprocessing, model building, evaluation, and interpretation of results.

UNIT - I   **Python - Data Structures, OOPS & Modules**   **9 Hours**

Data structures: Dictionaries - Maps - Hash Tables - Array Data Structures - Records - Structs - Data Transfer Objects - Sets and Multisets-Stacks (LIFOs) - Queues (FIFOs) ; Python : Python installation - Python OOPs - Polymorphism in OOPs programming - Python String Concatenation - Print Exception in Python - Python Libraries - Python Pandas - Python Matplotlib - Python Seaborn - Python SciPy - Chatbot in Python - Machine Learning using Python - Exploratory Data Analysis in Python - Open CV Python - Tkinter - Pythons Turtle Module - PyGame in Python - Pytorch - Scrapy - Web Scraping - Django - Python Programs - Types of Data structure in Python - Built in data structures - User defined data structures; Object Oriented Concepts and Design : APIs and Data Collection - Simple API - REST APIs & HTTP Requests - Web scraping - HTML for Web Scraping - file formats.

UNIT – II   **Python – Numpy, Pandas & DS Libraries**   **9 Hours**

Installation and setup : Anaconda Distribution - Anaconda Navigator to create a New Environment - Startup and Shutdown Process - Intro to the Jupyter Lab Interface - Code Cell - execution; Python : Basic datatypes - Operators - variables - Built in Functions - Custom Functions - String Methods - Lists - Index Positions and Slicing - Navigating Libraries using Jupyter Lab; Series : Create series object from a list and dictionary - The head and Tail methods - Passing Series to Python Built-In Functions – Methods for Data sorting ; Dataframe : Methods and Attributes between Series and DataFrames - Fill in Missing Values - Filtering data and methods in Dataframe - Data Extraction in dataframes - Working with Text Data - Merging Dataframes; Data Mining - Data Processing and Modelling - Data Visualization.

UNIT – III   **Visualization**   **9 Hours**

Introduction to Matplotlib - Matplotlib Basics - Matplotlib - Understanding the Figure Object - Matplotlib - Implementing Figures and Axes - Matplotlib - Figure Parameters - Matplotlib Styling - Legends - Matplotlib Styling - Colors and Styles - Advanced Matplotlib Commands - Introduction to Seaborn - Scatterplots with Seaborn – Distribution Plots - Part One - Understanding Plot Types - Distribution Plots - Part Two - Coding with Seaborn - Categorical Plots - Statistics within Categories - Understanding Plot Types - Categorical Plots - Statistics within Categories - Coding with Seaborn - Categorical Plots - Distributions within Categories - Understanding Plot Types - Categorical Plots - Distributions within Categories - Coding with Seaborn - Seaborn - Comparison Plots - Understanding the Plot Types - Seaborn - Comparison Plots - Coding with Seaborn - Seaborn Grid Plots - Seaborn - Matrix Plots.

UNIT – IV   Regression and Classification   9 Hours

Introduction to Linear Regression : Cost Functions - Gradient Descent - Python coding Simple - Overview of Scikit-Learn and Python - Residual Plots - Model Deployment and Coefficient Interpretation - Polynomial Regression - Theory and Motivation - Creating Polynomial Features - Training and Evaluation - Bias Variance Trade-Off - Polynomial Regression Choosing Degree of Polynomial - Model Deployment - Feature Scaling; Introduction to Cross Validation : Regularization Data Setup - Ridge Regression Theory - Lasso Regression - Background and Implementation - Elastic Net Feature Engineering and Data Preparation; Dealing with Outliers - Dealing with Missing Data - Evaluation of Missing Data - Filling or Dropping data based on Rows - Fixing data based on Columns - Dealing with Categorical Data - Encoding Options - Cross Validation - Test - Validation - Train Split - cross_val_score - cross validate - Grid Search; Linear Regression Project: The Logistic Function - Logistic Regression - Theory and Intuition; Linear to Logistic: Logistic Regression - Theory and Intuition - Linear to Logistic Math; Logistic Regression: Theory and Intuition Logistic Regression Model Training - Classification Metrics - Confusion Matrix and Accuracy - Classification Metrics - Precison, Recall, F1- Score - ROC Curves - Logistic Regression with Scikit-Learn - Performance Evaluation - Multi-Class Classification with Logistic Regression - Data and EDA – Model.

UNIT – V   Unsupervised and Advanced Classification Techniques   9 Hours

Introduction to KNN Section: KNN Classification, KNN Coding with Python - Choosing K, KNN Classification Project Exercise; Introduction & history of Support Vector Machines- Hyperplanes and Margins, Kernel Intuition, Kernel Trick and Mathematics; SVM with Scikit-Learn and Python – Classification, Regression Tasks; Introduction to Tree Based Methods- Decision Tree, Understanding Gini Impurity; Constructing Decision Trees with Gini Impurity, Coding Decision Trees; Introduction to Random Forests-Key Hyperparameters, Number of Estimators and Features in Subsets, Bootstrapping and Out-of-Bag Error; Coding Classification with Random Forest Classifier, Coding Regression with Random Forest Regressor, Advanced Models. Introduction to K-Means Clustering Section; K-Means Color Quantization; K-Means Clustering Exercise Overview, Solution; Introduction to Hierarchical Clustering, Coding - Data and Visualization,

Scikit-Learn; Introduction to Principal Component Analysis(PCA)-Manual Implementation in Python-SciKit-Learn.

Course Outcomes:

- Understand the basics of python and standard modules used for data science with hands-on.
- Understand the data structures and visualization used for data science with hands-on.
- Understand the data structures and visualization used for data science with hands-on.
- Understand the machine learning libraries used for data science with hands-on.
- Understand the Regression and Classification for data science with hands-on.
- Design, develop and test various classification and clustering models

Textbook(s):

1. "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython" by Wes McKinney, O'Reilly Media , 2nd Edition, 2017
2. "Data Science from Scratch First Principles with Python" by Joel Grus, O'Reilly Media, Inc., Second Edition, Released May 2019.

Reference Books(s) / Web links:

1. Alvaro Fuentes, Become a Python Data Analyst – By Packt Publishing (2018)
2. Bharti Motwani, Data Analytics using Python – By Wiley (2020)
3. Jules S. Damji, Learning Spark: Lightning-Fast Data Analytics, Second Edition – By Shroff/O'Reilly (2020)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3					2					1	
CO2	3				2								1
CO3	2	3	2	2									
CO4	3	2			2	2						1	
CO5	3		2			2		3					2

3- High mapping   2-Medium Mapping   1- Low Mapping

Sri Venkateswara College of Engineering and Technology
(Autonomous)

M.Tech. - I Semester CSE(DS)

25BDS02	MACHINE LEARNING TECHNIQUES	L	T	P	C
	(Program Elective Course - I)	3	0	0	3

Course Objectives:

- To recognize the characteristics of machine learning that make it useful to solve real-world problems.
- To understand the appropriate implementation of supervised, semi-supervised, and unsupervised learning techniques in real-world applications.
- To choose a suitable machine learning model, implement, and examine the performance of the chosen model for a given real-world problem.
- To understand cutting-edge technologies related to machine learning applications.

UNIT I **9 Hours**

Introduction: Definition of learning systems. Goals and applications of machine learning. Aspects of developing a learning system: training data, concept representation, function approximation. The concept learning task. Concept learning as search through a hypothesis space. General-to-specific ordering of hypotheses. Finding maximally specific hypotheses. Version spaces and the candidate elimination algorithm. Learning conjunctive concepts. The importance of inductive bias.

UNIT II **9 Hours**

Supervised Learning: Classification vs. Regression, Linear and Logistic Regression, Gradient Descent, Support Vector Machines, Kernels, Decision Trees, ML and MAP Estimates, KNearest Neighbor, Naive Bayes, Introduction to Bayesian Networks, Artificial Neural Networks.

UNIT III **9 Hours**

Unsupervised Learning: Partitioning based methods, Hierarchical methods, Density based methods, Gaussian Mixture Models, Learning with Partially Observable Data (EM). Dimensionality Reduction and Principal Component Analysis.

UNIT IV **9 Hours**

Optimization Techniques: Bias-Variance tradeoff, Regularization, Evaluation techniques for supervised and unsupervised learning.

UNIT V **9 Hours**

Other Learning techniques: Semi-supervised Learning, Active Learning, Reinforcement Learning.

Recommender System: Recommender system functions, understanding ratings, Applications of recommendation systems, Issues with recommender system, Collaborative Filtering, Content - based recommendation.

Course Outcomes:

- Students will be able to understand the mathematics and engineering sciences behind the functioning of machine learning.
- Students will be able to analyze the given dataset and data attributes for designing a machine learning based solution.
- Students will be able to identify different machine learning approaches, optimization techniques, and apply them on different problem domains.
- Students will be able to design and deploy machine learning solutions for real-world applications with popular machine learning tools.

Textbooks:

1. T. Mitchell, Machine Learning, McGraw Hill.
2. Ethem Alpaydın, Introduction to Machine Learning 3rd Edition, MIT Press
3. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012

Reference Books:

1. Marc Peter Deisenroth, A. Aldo Faisal and Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.
2. Shwartz and David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press.
3. C.M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
4. Andrew Ng, Machine Learning Yearning, 2018.

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Sri Venkateswara College of Engineering and Technology
(Autonomous)

M.Tech. - I Semester CSE(DS)

25BDS03	DATA ENGINEERING PRINCIPLES FOR ENTERPRISES	L	T	P	C
	(Program Elective Course - I)	3	0	0	3

Course Objectives:

The purpose of learning this course is to:

- distinguish various examples and use cases for each type of data formats.
- critique the benefits and limitations of ETL versus stream processing techniques.
- measure data quality metrics to assess accuracy, completeness, and consistency.
- construct effective storage solutions for large-scale data sets using relational databases, NoSQL databases, and distributed file systems.
- formulate strategies for addressing complex real-world data engineering challenges through best practices in data warehousing, big data analytics, and machine learning.

UNIT - I   Data Types and Formats   9 Hours

Introduction to Data Engineering – Data Engineering Ecosystem - Overview of Data Types and Formats - Types of Data - Structured vs. Unstructured Data - Formats of Data - Semi-Structured Data - Data Type Conversion and Transformation - Data Serialization - Choosing the Right Data Type and Format - Tools and Technologies for Data Types and Formats - The role of data engineering in the data lifecycle.

UNIT - II   Data Ingestion Techniques   9 Hours

Introduction to Data Ingestion - Streaming Data Ingestion - Batch Data Ingestion - Hybrid Data Ingestion - Data Ingestion vs. Data Integration - Data Ingestion Challenges - Tools and Solutions for Data Ingestion - Enterprise Data Platform- StreamSets DataOps Platform - Best Practices in DataOps - StreamSets Data Collector- Benefits of Data Ingestion - Data Ingestion Framework .

UNIT – III   Data Profiling and Visual Representation via Various Tools (Pandas)   9 Hours

Introduction to Data Profiling and Visualization - Exploratory Data Analysis (EDA) with Pandas - Steps Involved in Exploratory Data Analysis (EDA) Data Analysis (EDA) with Pandas - Market Analysis with Exploratory Data Analysis (EDA) - Data Analytics and Its Future Scope - Data Analytics with Python - Top Business Intelligence Tools - Application of Data Analytics - Retrieving and Cleaning Data - Exploratory Data Analysis and Feature Engineering - Inferential Statistics and Hypothesis Testing - Descriptive Statistics - Types of Descriptive Statistics -

Concepts of Populations, Samples, and Variables - Statistical Methods for Describing Data Characteristics - Real-World Applications of Descriptive Statistics using Excel - Types of Missing Data and Handling Techniques.

UNIT - IV   Storage and Retrieval Methods   9 Hours

Introduction To the Data Warehouses - Storage and Retrieval Introduction - Types of Data and Storage Methods - Local vs. Distributed Storage & Retrieval - Hardware Aspects of Storage & Retrieval - Choosing Storage Methods - Data Partitioning and Sharding - Data Replication and Redundancy - Data Compression and Encoding - Data Archiving and Retrieval - Backup and Disaster Recovery - Data Lifecycle Management.

UNIT - V   Data Lineage Analysis   9 Hours

Introduction to Data Lineage Analysis - Building a Data Flow - ETL (Extract, Transform, Load) Process - Usage of Data Warehouse - Edge Intelligence in Data Flow - Understanding Data Lineage - How Data Lineage Works - Benefits of Data Lineage - Data Lineage Tool Features-Data Engineering in Practice- Best practices of ETL processes.

Course Outcomes:

At the end of this course, learners will be able to:

- identify different data formats and their use cases, including structured, semi-structured, and unstructured data.
- discuss various data ingestion techniques, such as ETL and stream processing, highlighting their advantages and limitations.
- analyze data profiling results to identify and address quality issues.
- develop effective storage and retrieval strategies for large-scale data sets, including relational databases, NoSQL databases, and distributed file systems.
- implement data engineering principles to solve practical problems in data warehousing, big data analytics, and machine learning.

Textbooks:

1. Charles M.Judd, Data Analysis: A Model Comparison Approach To Regression, ANOVA, and Beyond 3rd Edition - By Routledge (2017)
2. Pierre-Yves Bonnefoy, EmericChaize, RaphaëlMansuy& Mehdi TAZI, The Definitive Guide to Data Integration 1st Edition - By Packt Publishing (2024).
3. Data Engineering with Python by Paul Crickard Packt Publishing (2020)

Reference Books:

1. Fundamentals of Data Engineering by Joe Reis and Matt Housley, O'Reilly Media(2022)
2. Python Data Science Handbook by Jake VanderPlas, O'Reilly Media(2016)
3. Data Management for Researchers by Kristin Briney, Elsevier(2015)

Sri Venkateswara College of Engineering and Technology
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M.Tech. - I Semester CSE(DS)

25BDS04	BIG DATA MINING (Program Elective Course - I)	L	T	P	C
		3	0	0	3

Course Objectives:

The objectives of this course are to
- To understand importance of big data and data analytics
- To learn Basic Data analytic methods
- To learn Basic Data analytic methods using R
- To get a knowledge on advanced analytical methods, technology and tools.

UNIT – I   **9 Hours**

Big data overview-State of the practice in Analytics-Key roles for new big data ecosystem Data Analytics Lifecycle-Data analytics lifecycle overview- Discovery- Data Preparation-Model Planning- Model Building Communicate Results operationalize

UNIT – II   **9 Hours**

Introduction to R - Exploratory Data Analytics-Statistical methods for evaluation Hadoop & Map Reduce framework for R, R with Relational Database Management Systems, R with Non-Relational (NoSQL) DBs

UNIT – III   **9 Hours**

Clustering-Overview of Clustering-K-means, Association Rules-Overview-Apriori Algorithm-Evaluation of candidate rules-An Example: Transactions in grocery Store-Validation and Testing-Diagnostics, Regression-Linear Regression-Logistic Regression-Reason to choose and Cautions-Additional Regression Models

UNIT – IV   **9 Hours**

Classification-Decision Trees-Naïve Bayes-Diagnostics of Classifiers-Additional classification methods, Time series Analysis, overview of Time series analysis-ARIMA Model-Additional methods, Text Analysis-Text analysis steps-A text analysis Example-Collecting raw Text-Representing Text- Term Frequency—Inverse document frequency(TFIDF)-Categorizing documents by Topics- Determining Sentiments-Gaining insights

UNIT – V   **9 Hours**

Analytics for Unstructured data-The Hadoop Ecosystem-NoSQL, In-Database Analytics-SQL Essentials-In-Database Text Analysis-Advanced SQL

Course Outcomes:

After completion of the course, the student will be able to

- Understand the big data concepts
- Utilize and apply the Analytical methods, Technology and tools in the industry.
- Understand Hadoop ecosystem and apply to solve real-life problems
- Design efficient algorithms for mining the data from large volumes

Textbooks:

1. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2015.
2. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3		2									1	
CO2	3			2	2								2
CO3	2		2		2								
CO4	3			2				2				2	
CO5													2

3- High mapping   **2-Medium Mapping**   **1- Low Mapping**

Sri Venkateswara College of Engineering and Technology
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M.Tech. - I Semester CSE(DS)

		L	T	P	C
25BDS05	**DATA PREPARATION AND ANALYSIS** (Program Elective Course - II)	3	0	0	3

Course Objectives:

The objectives of this course are to
- Understanding the Data formats, parsing and transformation.
- Analyze data cleaning and segmentation.
- Describe an analytic approach of clustering and visualization methods.
- Define appropriate boundaries for the visualization using R analysis.

UNIT – I   **9 Hours**

Data Gathering and Preparation: Data formats, parsing and transformation, Scalability and real- time issues

UNIT – II   **9 Hours**

Data preprocessing, Data Cleaning: Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation

Unit – III   **9 Hours**

Exploratory Analysis: Descriptive and comparative statistics, Clustering and association, Hypothesis generation

UNIT – IV   **9 Hours**

Visualization: Designing visualizations, Time series, Geolocated data, Correlations and connections, Hierarchies and networks, interactivity

UNIT – V   **9 Hours**

Visualizations using R

Course Outcomes:

After Completion of the course the student will be able to
- Apply the data parsing and transformation.
- Solve by using various data cleaning techniques.
- Apply clustering and visualization methods
- Analyze the various methods for the visualization using R.

Textbooks:

1. Glenn J. Myatt, Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, John Wiley Publishers, 20014.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3						2		1			1	
CO2	2						2		1				1
CO3	2						2		2			2	
CO4	2						2		2				

3- High mapping   **2-Medium Mapping**   **1- Low Mapping**

Sri Venkateswara College of Engineering and Technology
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M.Tech. - I Semester CSE(DS)

25BDS06	SQL AND NoSQL FOR DATA SCIENCE (Program Elective Course - II)	L	T	P	C
		3	0	0	3

Course Objectives:

The purpose of learning this course is to:

- apply fundamental algorithmic ideas to process data
- understand the various functionalities of database
- construct models using MySQL and NoSQL
- apply various sub queries in MySQL
- implement various constraints and transactional queries.

UNIT – I   SQL Fundamentals   9 Hours

Data and Types of Data, DBMS Concepts and Relational Database Management System, Create Database and Drop Database, Data Types, Types of Constraints, Data Manipulation Language and examples, Data Definition Language commands with examples, Data Definition Language L, DML Commands, Select Clause ,where clause, Operators with where clause, Limit, Compound search condition, Working with NULL Values, Date Functions and Formatting, To_Date, To_Number, To_Char, SQL Constraints, NOT NULL, UNIQUE, PRIMARY KEY, FOREIGN KEY, CHECK,DEFAULT, SELECT with predicates, Comparison Operator, Between, IN, Like, Wildcard Filters, LIMIT

T1: SQL – Basic SELECT Commands, Create Table,

T2: Implementation of SELECT, WHERE, Date functions,

T3: Explore usage of Constraints, Usage of LIKE, BETWEEN, LIMIT, Comparison operator

UNIT – II   SQL Functions   9 Hours

Operator Precedence, Single row Functions, Number Functions and their various examples, Round, Trunc, Floor, Ceil with different parameters and examples, String Function, Upper, Lower, Instr, Substr, lstrip ,rstrip, concat, Date Function with examples ,Using Bin, Cast, Coalesce, Sorting using Order By in ascending and descending order, Conditional statements, IFNULL, GROUP Functions count(), Avg(), Max(), Min(),sum(), GROUP By with aggregate function, Multiple Grouping Columns, Null values in Grouping Clause, Filtering using Having Clause, Aggregation with Having clause and Ordering of While and Having Clause, Having with-out Group by, Restriction on Grouped Queries.

T4: Usage of Single row functions,

T5: Implementation of Date Functions and Conditional Statements,

T6: Interpreting & Implementation of Group By with/without Having Clause

UNIT – III   Joins and Subqueries   9 Hours

Introduction to Join, ER Diagram, Simple Join, Table Aliases, Multi table joins, Joins with Group by JOINS with WHERE / ON/USING, Join with Row selection, Natural Join, Equi Join, Non Equi Joins, Left Join, Right Join, Syntax and Different examples of Left Join and Right Join, Full Outer Join, Cross joins with examples and usage, Windows Functions, Rules for Multi Join query, Sub Queries - Need, Single row and Multirow operators, Types, Correlated Subqueries.

T7: Implementation of Different types Joins in MYSQL,

T8: Implementation of Different types of subqueries, windows function

T9 : Implementation of correlated sub queries

UNIT – IV   NoSQL Fundamentals   9 Hours

Overview and History of NoSQL Databases. Definition of the Four Types of NoSQL Database, The Value of Relational Databases, Getting at Persistent Data, Concurrency, Integration, Impedance Mismatch, Application and Integration Databases, Attack of the Clusters, The Emergence of NoSQL. Comparison of relational databases to new NoSQL stores, MongoDB, Cassandra, HBASE, Neo4j use and deployment, Application, RDBMS approach, Challenges NoSQL approach, Key-Value and Document Data Models, Column-Family Stores.

T10: Implement aggregation and indexing with suitable example using MongoDB,

T11: Implement Map reduces operation with suitable example using MongoDB

T12: Practice CRUD (Create, Read, Update, and Delete) operations on the databases: MongoDB

UNIT – V   Transactions with NoSQL   9 Hours

NoSQL Key/Value databases using MongoDB, Document Databases, Document oriented Database Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Web Analytics or Real-Time Analytics, E-Commerce Applications, Complex Transactions Spanning Different Operations, Queries against Varying Aggregate Structure.

T13: Design and implement aggregation pipeline using MongoDB,

T14: Practice with 'macdonalds' collection data for document-oriented database. Import restaurants collection and apply some queries to get specified output.

T15: Develop an application using any of using NOSQL

Course Outcomes:

At the end of this course, learners will be able to:

- comprehend basic methods of processing data from real world problems
- convert data into actionable insights
- build data model into advanced actionable insights
- apply different kinds of sub queries in real world application.
- understand different constraints and transactional queries to application

Textbooks:

1. Anthony Molinaro, Robert De Graaf Nield, T., Safari "SQL Cookbook, 2E: Query Solutions and Techniques for All SQL Users" O'Reilly Media Company,2019.
2. Lynn Beighley, Sadalage, P. & Fowler, "Head First SQL: Your Brain on SQL -- A Learner's Guide NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence" , Wiley Publications,1st Edition ,2019.

Reference Books:

1. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Pearson publication, 7th edition, 2021.
2. Avi Silberschatz, Henry F. Korth,S. Sudarshan, "Database System Concepts" , McGraw-Hill, 7th Edition,2019.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3								3	2
CO2	3	3	3	3	1								3	3
CO3	3	3	3	3	2								3	2
CO4	3	3	3	2	2								3	3
Average	3	3	3	2.75	2								3	2.5

3- High Mapping   **2-Medium Mapping**   **1- Low Mapping**

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M.Tech. - I Semester CSE(DS)

25BDS07	WEB AND TEXT ANALYTICS (Program Elective Course - II)	L	T	P	C
		3	0	0	3

Course Objectives:

The objectives of this course are to

- Provide overview and the need for web analytics.
- Expose to the fundamentals how web analysis.
- Give the measuring strategy and effects of web analytics
- Identify the various types of testing and reporting methods.
- Describe the metrics to analyze the web data
- Provide exposure to usage of web analytic tools.

UNIT – I   **9 Hours**

INTRODUCTION TO WEB ANALYTICS: Web analytics approaches –Web analytics works: page tagging, metrics and dimensions, Interaction with data- Goals

UNIT – II   **9 Hours**

WEB ANALYTICS: Learning about user through web analytics: Visitor Analysis – Traffic analysis – Analyzing how people use you content – Click-path analysis.

UNIT – III   **9 Hours**

MEASURING THE EFFECTS: Segmentation – Paring the data with UX methods – Measuring the effects of changes: types of changes. Measuring behavior within pages.

UNIT – IV   **9 Hours**

TEXT ANALYTICS: Text analytics and text mining - Future of text mining - Practice areas of text analytics - Finding the appropriate solution to a problem - Visualizing the domains of text analytics.

UNIT – V   **9 Hours**

CLUSTERING: Text Capturing, sorting, sifting, stemming and matching – word cloud, wordless, and beyond –Clustering document using words – sentiment and counting.

Course Outcomes:

After Completion of the course, the student will be able to

- Explore Knowledge in web data.
- Describe the knowledge of various types of testing
- Study real-time websites for enhancing business performance.
- Describe the knowledge of clustering in text analysis.
- Predict the future using text analytics.
- Analyze the techniques for text and web analytics.

Textbooks:

1. Michael Beasley "Practical Web Analytics for User Experience", Elsevier, ISBN :978-0-12 404619-1, 2013.
2. Brian Clifton, "Advanced Web Metrics with Google Analytics", 3rd Edition, Sybex, ISBN-10: 1118168445, 2012.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3								3				2
CO2	1						2		2			2	
CO3	3												
CO4	3								1				1
CO5	1						2		3		2		

3- High Mapping   **2-Medium Mapping**   **1- Low Mapping**

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M.Tech. - I Semester CSE(DS)

25BDS08	DATA PREPARATION AND ANALYSIS LAB	L	T	P	C
		0	0	4	2

Course Objectives:

- To make students understand learn about a Big Data –R Programming , way of solving problems.
- To teach students to write programs in RStudio to solve problems with predefined R Packages on synthetic datasets.

Introduction to R Programming:

What is R and RStudio?

R is a statistical software program. It has extremely useful tools for data exploration, data analysis, and data visualization. It is flexible and also allows for advanced programming. RStudio is a user interface for R, which provides a nice environment for working with R.

1. Write an R program to evaluate the following expression ax+b/ax-b.
2. Write an R program to read input from the keyboard(hint: readLine()).
3. Write an R program to find the sum of n natural numbers: 1+2+3+4+….n
4. Write an R program to read n numbers.
   (i) Sum of all even numbers (ii) Total number of even numbers.

5. Write an R program to read n numbers.
   (i) Total number of odd numbers (ii) Sum of all odd numbers

6. Write an R program to to obtain
   (i)sum of two matrices A and B (ii) subtraction of two matrices A and B
   (iii) Product of two matrices.

7. Write an R program for " declaring and defining functions "
8. Write an R program that uses functions to add n numbers reading from keyboard.
9. Write an R program uses functions to swap two integers.
10. Write an R program that use both recursive and non-recursive functions for implementing the Factorial of a given number, n .
11. Write an R program to reverse the digits of the given number. {example 1234 to 4321}
12. Write an R program to implement
    (i)Linear search (ii) Binary Search.

13. Write an R program to implement
    (i)Bubble sort (ii) Selection sort.

14. Write a R program to implement the data structures
    (i) Vectors (ii) Array (iii) Matrix (iv) Data Frame (v) Factor

15. Graphical Analysis: Creating a simple graph, Modifying the plots and lines of a graph. Modifying Title and Subtile, Modifying Axes of a Graph, Adding Legend on a Graph, Special Graphs (Using pie charts, barplot, histograms scatter plots), Multiple Plots.

16. Descriptive Statistics: Measure of Central Tendency (Mean, Median and Mode), Measure of Positions (Quartiles, Deciles, Percentiles and Quantiles), Measure of Dispersion (Range, Median, Absolute deviation about median, Variance and Standard deviation), Measure of Distribution (Skewness and Kurtosis), Box and Whisker Plot (Box Plot and its parts, Using Box Plots to compare distribution).

17. Construct classification and regression trees

18. Implement K-Means and Hierarchical

19. Experiments based on Linear Regression and Multiple Linear Regression Methods.

20. Implement K-nearest neighbors and Linear Discriminant Analysis.

21. Implement Leave-One-Out Cross-Validation and k-Fold cross-validation on any simulated data set.

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M.Tech. - I Semester CSE(DS)

25BDS09	MACHINE LEARNING TECHNIQUES LAB	L	T	P	C
		0	0	4	2

Course Objective:

- To recognize data attribute types and data preprocessing techniques.
- To understand and apply supervised, unsupervised, and other learning techniques.
- To understand and apply machine learning optimization techniques.
- To understand and apply various machine learning algorithm performance evaluation techniques.
- To choose a suitable machine learning model, implement, and examine the performance of the chosen model for a given real world problem.
- To understand cutting edge technologies related to machine learning applications.

List of Exercises

1. Write programs to achieve Data preprocessing using NumPy, Pandas, matplotlib, Scikit-learn.
2. Write programs to implement Supervised Learning by using Linear and logistic regression, Naïve bayes, Decision Tree, Support Vector Machines, Neural Networks.
3. Write programs to implement Unsupervised Learning by using k-means, Agglomerative, DBSCAN, Dimensionality Reduction and Principal Component Analysis.
4. Optimization Techniques: Write programs to implement Bias-Variance tradeoff, Cross-validation, Regularization, Precision, Recall and F-measure.
5. Other Learning techniques: Write programs to Implement Reinforcement Learning, Recommender Systems, Anomaly Detection.
6. Write an application of Machine Learning for Texts, Image, Time-series data.

Course Outcomes:

After Completion of the course, the student will be able to

- Understand the mathematics and engineering sciences behind the functioning of machine learning.
- Analyze the given dataset and data attributes for designing a machine learning-based solution.
- Identify different machine learning approaches, optimization techniques, and apply them on different problem domains.

- Design and deploy machine learning solutions for real-world applications with popular machine learning tools.

Textbooks:

1. Andreas C. Müller and Sarah Guido, Introduction to Machine Learning with Python: A Guide for Data Scientists, O'Reilly.

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M.Tech. - I Semester CSE(DS)

25BMB01	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		2	0	0	2

Course Objective:

- Identify an appropriate research problem in their interesting domain.
- Understand ethical issues understand the Preparation of a research project thesis report.
- Understand the Preparation of a research project thesis report.
- Understand the law of patent and copyrights.
- Understand the Adequate knowledge on IPR

UNIT – I   **9 Hours**

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, scope, and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT – II   **9 Hours**

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT – III   **9 Hours**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT – IV   **9 Hours**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT – V   **9 Hours**

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Course Outcomes:

After Completion of the course, student will be able to

- Analyze research related information.
- Follow research ethics.

- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Textbooks:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

Reference Books:

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Asimov, "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.

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M.Tech. - I Semester CSE(DS)

25BHS02	ENGLISH FOR RESEARCH PAPER WRITING Audit Course - I	L	T	P	C
		2	0	0	0

Course Objectives:

This course will enable students:

- Understand the essentials of writing skills and their level of readability
- Learn about what to write in each section
- Ensure qualitative presentation with linguistic accuracy

UNIT - I   **10 Hours**

Overview of a Research Paper- Planning and Preparation- Word Order- Useful Phrases - Breaking up Long Sentences-Structuring Paragraphs and Sentences-Being Concise and Removing Redundancy -Avoiding Ambiguity

UNIT – II   **10 Hours**

Essential Components of a Research Paper- Abstracts- Building Hypothesis-Research Problem - Highlight Findings- Hedging and Criticizing, Paraphrasing and Plagiarism, Cauterization

UNIT – III   **10 Hours**

Introducing Review of the Literature – Methodology - Analysis of the Data-Findings - Discussion-Conclusions-Recommendations.

UNIT – IV   **9 Hours**

Key skills needed for writing a Title, Abstract, and Introduction

UNIT – V   **9 Hours**

Appropriate language to formulate Methodology, incorporate Results, put forth Arguments and draw Conclusions.

Course Outcomes:

Student will be able to

- Understand the significance of writing skills and the level of readability
- Analyze and write title, abstract, different sections in research paper

- Develop the skills needed while writing a research paper

Textbooks:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) Model Curriculum of Engineering & Technology PG Courses [Volume-I]
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

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M.Tech. - I Semester CSE(DS)

		L	T	P	C
25BST27	**DISASTER MANAGEMENT** Audit Course - I	2	0	0	0

Course Objectives:

This course will enable students:

- Learn to demonstrate critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from
- Multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations
- Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

UNIT – I   **9 Hours**

Introduction:
Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Man-made Disasters: Difference, Nature, Types and Magnitude.
Disaster Prone Areas in India:
Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post- Disaster Diseases and Epidemics

UNIT – II   **9 Hours**

Repercussions of Disasters and Hazards:
Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanoes, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT – III   **9 Hours**

Disaster Preparedness and Management:

Preparedness: Monitoring of Phenomena Triggering A Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT – IV   **9 Hours**

Risk Assessment Disaster Risk:
Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

UNIT – V   **9 Hours**

Disaster Mitigation:
Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation, Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Textbooks:

1. R.Nishith, Singh AK,"Disaster Management in India: Perspectives, issues and strategies
2. "'New Royal Book Company. ' Sahni, Pardeep et all. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
3. Goel S.L., Disaster Administration and Management Text and Case Studies, Deep & Deep Publication Pvt. Ltd., New Delhi.

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M.Tech. - I Semester CSE(DS)

25BHS03	**SANSKRIT FOR TECHNICAL KNOWLEDGE** Audit Course - I	L	T	P	C
		2	0	0	0

Course Objectives:

- To get a working knowledge of illustrious Sanskrit, the scientific language in the world
- Learning Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects, enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge
- Knowledge from ancient literature

UNIT – I   **9 Hours**

Alphabets in Sanskrit,

UNIT – II   **9 Hours**

Past/Present/Future Tense, Simple Sentences

UNIT – III   **9 Hours**

Order, Introduction of roots

UNIT – IV   **9 Hours**

Technical information about Sanskrit Literature

UNIT – V   **9 Hours**

Technical concepts of Engineering-Electrical, Mechanical, Architecture, and Mathematics

Course Outcomes:

After Completion of the course, the student will be able to

- Understanding basic Sanskrit language
- understood Ancient Sanskrit literature about science & technology
- to develop logic in students

Textbooks:

1. "Abhyaspustakam" –Dr.Vishwas, Sanskrit-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha- Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean Books (P) Ltd., New Delhi

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M.Tech. - II Semester CSE(DS)

25BDS10	DATA ANALYTICS	L	T	P	C
		3	0	0	3

Course Objectives:

- Explicate how to design, construct, and quality check a dataset before using it to a build prediction model.
- Understanding the importance about feature selection in data models.
- Understanding how information theory, similarity score and Probability theory can be used to build prediction models.

UNIT – I   **9 hours**

Introduction to Data Mining:
Introduction to Data Mining, Challenges in Data Mining, Data Mining Tasks, Machine Learning, Predictive Data Analytics Lifecycle, Predictive Data Analytics Tools
Exploring Data:
Different types of data, Normal Distribution, Identifying Data Quality Issues, Missing Values, Irregular Cardinality, Outlier, Advanced Data Exploration, Visualizing Relationships Between Features, Measuring Covariance and Correlation, Data Preparation, Normalization, Binning, Sampling

UNIT – II   **9 hours**

Feature Selection:
Feature Reduction- Feature Selection, Statistics for Feature Selection, Chi-Squared Test for Feature Selection, ANOVA F-test for Feature Selection, RFE feature selection, Dimensionality Reduction and PCA

UNIT – III   **9 hours**

Decision Tree and Similarity-based Learning
Decision Trees, Shannon's Entropy Model, Information Gain, Standard Approach: The ID3 Algorithm, Feature Space, Measuring Similarity Using Distance Metrics, Standard Approach: The Nearest Neighbor Algorithm, Extensions and Variations, Handling Noisy Data, Efficient Memory Search, Data Normalization, Predicting Continuous Targets

UNIT – IV   **9 hours**

Probability-based Learning:
Fundamentals, Bayes' Theorem, Bayesian Prediction, Conditional Independence and Factorization, Standard Approach: The Naive Bayes Model
Error-based Learning:

Simple Linear Regression, Measuring Error, Error Surfaces, Standard Approach: Multivariable Linear Regression with Gradient Descent, Multivariable Linear Regression, Gradient Descent, Choosing Learning Rates and Initial Weights.

UNIT – V   **9 hours**

Distributed Machine Learning
Data Parallelism - Splitting Input Data, Parameter Server and All-Reduce - Building a Data Parallel Training and Serving Pipeline-Model Parallelism - Splitting the Model-Pipeline Input and Layer Split- Implementing Model Parallel Training and Serving Workflows - Federated Learning and Edge Devices, Contemporary Issues

Course Outcomes:

Upon completion of the course the student will be able to

- Students will understand the basic concept of data mining and life cycles of data analytics.
- Analyze and Apply the different data preprocessing techniques.
- Analyze the characteristics of the data and its important feature.
- Apply the prediction model for decision making for a given set of problems.
- Students will understand the concept of distributed machine learning.

Textbooks:

1. John D. Kelleher, Brian Mac Namee, Aoife D'Arcy - Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, MIT Press 2020, 2nd Edition
2. Jason Brownlee -Data Preparation for Machine Learning: Data Cleaning, Feature Selection, and Data Transforms in Python, First Edition, 2020. Edition.

Reference Books:

1. Pang-Ning Tan; Michael Steinbach; Anuj Karpatne; Vipin Kumar -Introduction to Data Mining. By: Publisher: Pearson, Edition: 2nd, 2019.
2. Guanhua Wang-Distributed Machine Learning with Python, Packt Publishing, 2022.

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M.Tech. - II Semester CSE(DS)

25BDS11	BIG DATA FRAMEWORKS AND TECHNOLOGIES	L	T	P	C
		3	0	0	3

Course Objectives:

- To understand the need of a framework to store and process the big data.
- To have knowledge on the Big Data Technologies for processing the Different types of Data.
- To understand the advanced frame work for faster accessing and processing of Big Data.

UNIT – I   **9 hours**

Big Data:
Understanding Big Data: Concepts and terminology, Big Data Characteristics, Different types of Data, Identifying Data Characteristics - Big Data Architecture - Big Data Storage: File system and Distributed File System, NoSQL, Sharding, Replication, Sharding and Replication, ACID and BASE Properties.

UNIT – II   **9 hours**

Hadoop Framework:
Hadoop Architecture - Hadoop Distributed File System (HDFS) –YARN – Hadoop I/O – Map Reduce: Developing a map-reduce application – Map-reduce working procedure – Types and Formats - Features of Map reduce: sorting and joins- Pipelining MapReduce jobs.

UNIT – III   **9 hours**

Hadoop Technologies-PIG:
Introduction, Parallel processing using Pig, Pig Architecture, Grunt, Pig Data Model-scalar and complex types. Pig Latin- Input and output, Relational operators, User defined functions -Working with scripts. Hadoop Operations.

UNIT – IV   **9 hours**

Hive:
Introduction-Hive modules, Data types and file formats, Hive QL-Data Definition and Data Manipulation-Hive QL queries, Hive QL views- reduce query complexity. Hive scripts. Hive QL Indexes- Aggregate functions- Bucketing vs Partitioning.
Spark:
Overview of Spark – Hadoop Overview of Spark – Hadoop vs. Spark – Cluster Design – Cluster Management – performance, Application Programming interface (API): Spark Context, Resilient Distributed Datasets, Creating RDD, RDD Operations, and Saving RDD - Lazy Operation – Spark Jobs.

UNIT – V   **9 hours**

Data Analysis with Spark Shell:
Writing Spark Application - Spark Programming in Scala, Python, R, Java - Application Execution
Spark SQL and GraphX:
SQL Context – Importing and Saving data – Data frames – using SQL – GraphX overview – Creating Graph – Graph Algorithms - Contemporary Issues.

Course Outcomes:

Upon completion of the course the student will be able to
- Understand the need of new frame work to deal with huge amounts of Data.
- Demonstrate the Hadoop framework Hadoop Distributed File System and MapReduce.
- Demonstrate the Pig architecture and evaluation of pig scripts.
- Describe the Hive architecture and execute SQL queries on sample data sets.
- Demonstrate spark programming with different programming languages and graph algorithms.

Textbooks:

1. Thomas Erl, Wajid Khattak, and Paul Buhler, Big Data Fundamentals: Concepts, Drivers &Techniques, Pearson India Education Service Pvt. Ltd., First Edition, 2016.
2. Tom White, Hadoop: The Definitive Guide, O'Reilly Media, Inc., Fourth Edition, 2015.

Reference Books:

1. Alan Gates, Programming Pig Dataflow Scripting with Hadoop, O'Reilly Media, Inc, 2011.
2. Jason Rutherglen, Dean Wampler, Edward Caprialo, Programming Hive, O'ReillyMedia Inc,2012
3. Mike Frampton, "Mastering Apache Spark", Packt Publishing, 2015.

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M.Tech. - II Semester CSE(DS)

25BDS12	MULTIVARIATE TECHNIQUES FOR DATA ANALYSIS Program Elective Course - III	L	T	P	C
		3	0	0	3

Course Objectives:

The objectives of this course are to

- Data characteristics and form of Distribution of the Data Structures.
- Understanding the usage of multivariate techniques for the problem under the consideration.
- For drawing valid inferences and to plan for future investigations.

UNIT I - INTRODUCTION TO MULTIVARIATE ANALYSIS   9 Hours

Meaning of Multivariate Analysis, Measurements Scales - Metric measurement scales and Non metric measurement scales, Classification of multivariate techniques (Dependence Techniques and Inter-dependence Techniques), Applications of Multivariate Techniques in different disciplines.

UNIT II – FACTOR ANALYSIS   9 Hours

Factor Analysis: Meanings, Objectives and Assumptions, Designing a factor analysis, Deriving factors and assessing overall factors, Interpreting the factors and validation of factor analysis.

UNIT III – CLUSTER ANALYSIS   9 Hours

Cluster Analysis: Objectives and Assumptions, Research design in cluster analysis, Deriving clusters and assessing overall fit (Hierarchical methods, Non Hierarchical Methods and Combinations), Interpretation of clusters and validation of profiling of the clusters.

UNIT IV - DISCRIMINANT ANALYSIS   9 Hours

Discriminant Analysis- concept, objective and applications. Procedure for conducting discriminant analysis. Stepwise discriminate analysis and Mahalanobis procedure. Logit model.

UNIT V – LINEAR PROGRAMMING   9 Hours

Linear Programming problem - Formulation, graphical method, simplex method. Integer Programming. Transportation and Assignment problem.

Course Outcomes:

After Completion of the course the student will be able to

- Understand and Apply various Multivariate Techniques in different disciplines.
- Explain what multivariate analysis is and when its application is appropriate.
- Discuss the nature of measurement scales and their relationship to multivariate techniques.

- Define the specific techniques included in multivariate analysis.
- Determine which multivariate technique is appropriate for a specific research problem.
- Understand the six-step approach to multivariate model building

Textbooks:

1. Joseph F Hair, William C Black et. al , "Multivariate Data Analysis" , Pearson Education,7th edition, 2013.
2. T. W. Anderson, "An Introduction to Multivariate Statistical Analysis, 3rd Edition", Wiley,2003.
3. William r Dillon, John Wiley & Sons, "Multivariate Analysis Methods and Applications", Wiley, 1984.
4. Naresh K Malhotra, Satyabhusan Dash, "Marketing Research and Applied Orientation", Pearson, 2011.
5. Hamdy A Taha, "Operations Research", Pearson, 2012.
6. S R Yaday, A K Malik, "Operations Research", Oxford, 2014.

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M.Tech. - II Semester CSE(DS)

25BDS13	SECURITY FOR DATA ENGINEERING Program Elective Course - III	L	T	P	C
		3	0	0	3

Course Objectives:

- To Understand the Intersection of Cyber Security and Data Science
- To Identify and Mitigate Security Risks in Data Science Projects
- To Apply Data Privacy Regulations and Best Practices
- To Implement Secure Data Handling Practices
- To Utilize Machine Learning for Threat Detection and Security Analysis

UNIT – I   **9 Hours**

Introduction to Cyber Security and Data Science:
Overview of Cyber Security and Data Science - Definitions and Concepts - Intersection of Cyber Security and Data Science - Cyber Threat Landscape - Types of Cyber Threats - Attack Vectors and Techniques - Impact of Cyber Attacks on Data Science Processes - Foundations of Data Science - Data Collection and Sources - Data Storage and Management – Data Processing and Analysis Techniques

UNIT – II   **9 Hours**

Foundations of Cyber Security:
Principles of Cyber Security - Confidentiality, Integrity, and Availability (CIA) - Authentication and Authorization - Encryption and Cryptography - Secure Data Handling - Data Classification and Sensitivity - Data Masking and Anonymization - Secure Data Transfer and Sharing - Data Privacy and Compliance - Privacy Regulations (GDPR, HIPAA) - Data Governance and Compliance Frameworks - Ethical Considerations in Data Science and Cyber Security

UNIT – III   **9 Hours**

Data Privacy and Protection:
Data Privacy and Protection -Secure Data Sharing and Transfer - Secure File Transfer Protocols - Secure Data Exchange Platforms - Securing Data Collection Systems - Best Practices for Secure Data Storage - Cloud Security and Data Privacy - Secure Data Transfer and Backup Strategies - Data Retention Policies and Compliance

UNIT – IV   **9 Hours**

Threat Detection and Incident Response:
Threat Detection and Incident Response - Security Information and Event Management (SIEM) - Log Management and Analysis - Real-time Threat Detection - Incident Response Frameworks - Preparation, Identification, Containment, Eradication, Recovery - Forensic Analysis Techniques -

Machine Learning for Cyber Security - Threat Prediction and Classification - Behavioural Analysis and User Profiling

UNIT – V   **9 Hours**

Advanced Topics in Cyber Security for Data Science:
Advanced Topics in Cyber Security for Data Science - Adversarial Machine Learning - Evasion Attacks - Defence Mechanisms - Secure Machine Learning Models - Privacy-Preserving Machine Learning - Federated Learning - Ethical and Legal Considerations - Bias and Fairness in Cyber Security - Ethical Hacking and Responsible Disclosure.

Course Outcomes:

After completion of this course, the student will be able to

- Understand the Fundamentals of Cyber Security
- Implement Secure Data Handling Practices
- Analyze Security Risks in Data Science Projects
- Develop Threat Detection and Response Strategies
- Design Ethical and Privacy-Preserving Data Science Solutions

Textbooks:

1. M Lakshmikanth "Indian Polity", McGraw Hill Education, 5th edition 2017.
2. Durga Das Basu, "Introduction to the Constitution of India ", Lexis Nexis, New Delhi., 21st edition, 2013.

Reference Books:

1. "Data Science for Cyber-Security" by Nicholas A Heard, Niall M Adams, Patrick Rubin delanchy, Publisher: World Scientific Europe Ltd, 2018
2. "Cryptography and Network Security - Principles and Practice" by William Stallings 7th Edition, Pearson, 2017.
3. "Security Data Science: The Guide to Analyzing Threats and Attacks" by Julian Hillebrand and Heiko Tietze, Publisher: Springer
4. Security, Privacy, and Trust in Modern Data Management (Data-Centric Systems and Applications) by Milan Petkovic, Willem Jonker 2007th Edition, Springer

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M.Tech. - II Semester CSE(DS)

25BDS14	STATISTICAL MACHINE LEARNING Program Elective Course - III	L	T	P	C
		3	0	0	3

Course Objectives:

- To grasp the mathematical concepts necessary for carrying out machine learning
- To comprehend data handling techniques for executing machine learning tasks.
- To familiarise with various supervised learning algorithms
- To understand the different algorithms used in unsupervised learning.
- To grasp the foundational concepts of Neural networks.

UNIT - I   Fundamentals of Machine Learning   9 Hours

Linear Algebra - matrix vector operations, Eigen Values, Eigen Vectors; Orthogonality; Gaussian distribution; Gradient Descent; Prior probability; Bayes rule; Gaussian normal distribution

Role of machine Learning in computer science and problem solving; problem formulation; Role of Loss Functions and Optimization; Types of machine learning.

UNIT – II   Data Management   9 Hours

Acquisition; Representation; Pre-processing; transformation; Principal Component Analysis; Autoencoders; Overfitting; Underfitting, Data Management using NumPy

UNIT – III   Supervised Learning   10 Hours

Regression - Linear, Logistic, Ridge; Decision tree classifiers; Support Vector Machines; Naïve Bayes classifier; Random Forest; AdaBoost; Gradient Boost; Multi-Layer Perceptron; Exploring Supervised Learning using Pandas and Sci-kit Learn

UNIT - IV   Unsupervised Learning   10 Hours

Clustering - k-means, Hierarchical, DBSCAN; Association – Apriori, FP-growth; Applications, Exploring Unsupervised Learning using Pandas and Sci-kit Learn

UNIT – V   Neural Networks   7 Hours

Types of Network Architectures, Feed forward Networks, Activation functions, Linear Separability problem, Back Error Backpropagation, Case studies in Machine Learning

Course Outcomes:

At the end of this course, learners will be able to:

- apply suitable mathematical concepts to carry out machine learning
- acquire and process data for performing machine learning tasks.
- choose an apply appropriate supervised learning model
- determine the suitable type of unsupervised learning for the given problem.

- implement Neural network algorithms on applications

Textbooks:

1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press (23 April 2020)
2. Tom M. Mitchell- Machine Learning - McGraw Hill Education, International Edition
3. Aurélien Géron Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, Inc. 2nd Edition
4. Ian Goodfellow, Yoshoua Bengio, and Aaron Courville Deep Learning MIT Press Ltd, Illustrated edition
5. Christopher M. Bishop Pattern Recognition and Machine Learning - Springer, 2nd edition
6. Trevor Hastie, Robert Tibshirani, and Jerome Friedman - The Elements of Statistical Learning: Data Mining, Inference, and Prediction - Springer, 2nd edition

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M.Tech. - II Semester CSE(DS)

25BDS15	DATA STORAGE TECHNOLOGIES AND NETWORKS	L	T	P	C
	Program Elective Course - IV	3	0	0	3

Course Objectives:

The objectives of this course are to

- Understand the various storage media and technologies.
- Describing the memory Hierarchy and performance issues.
- Elaborate the different large storage devices and its Architecture.
- Understanding Storage Area Networks.

UNIT I   **9 Hours**

Storage Media and Technologies – Magnetic, Optical and Semiconductor Media, Techniques for read/write Operations, Issues and Limitations.

UNIT II   **9 Hours**

Usage and Access – Positioning in the Memory Hierarchy, Hardware and Software Design for Access, Performance issues.

UNIT III   **9 Hours**

Large Storage – Hard Disks, Networked Attached Storage, Scalability issues, Networking issues.

UNIT IV   **9 Hours**

Storage Architecture - Storage Partitioning, Storage System Design, Caching, Legacy Systems.

UNIT -V   **9 Hours**

Storage Area Networks – Hardware and Software Components, Storage Clusters/Grids. Storage QoS– Performance, Reliability, and Security issues, storage appliances.

Course Outcomes:

After Completion of the course the student will be able to

- Analyze the various storage media and technologies and learn Storage System Architecture
- Identify the performance issues of memory and network.
- Understand the different large storage devices and its Architecture.
- Understanding security, QoS and its Storage of clusters and Grids

Textbooks:

1. The Complete Guide to Data Storage Technologies for Network-centric Computing, Computer Technology Research Corporation, 1998.

Reference Books:

1. Nigel Poulton, Data Storage Networking: Real World Skills for the CompTIA Storage, Sybex, Wiley, 2014

M.Tech. - II Semester CSE(DS)

25BDS16	ADVANCED DATA VISUALIZATION	L	T	P	C
	Program Elective Course - IV	3	0	0	3

Course Objectives:

The purpose of learning this course is to:

- understand the basics of data visualization through Tableau
- gain knowledge on maps and plotting maps with Tableau
- get introduced to plat and charts for data visualization
- infer the insights of the problem statement by story and related techniques
- know about VizQL, and Tableau Prep

UNIT – I   Introduction to Tableau   9 Hours

Introduction to Tableau - Data Connection using Tableau Desktop, Visual Analytics- Basic Charts Data Granularity, Groups & Sets, Filters, Calculations in Tableau - Types of Calculations, Operators and syntax Conventions, Quick Table Calculations, Date Math, Data Aggregations, Custom aggregations and ratios, Organising Data, Formatting Data using labels and ToolTip, Annotations, Trendline, Reference line, K Means Clusters. Perform Sorting, Filtering and Grouping techniques in Tableau, Using the problem statement, perform the tableau calculations Identify the trends in given dataset using Tableau

UNIT - II   Map Boards and Calculated Parameter   9 Hours

Forecasting, confidence interval, Reference lines and bands, Working with Maps, Plotting Latitude and longitude, Working with Unrecognized Locations, Working with coordinate points, Customizing geocoding, polygon maps , WMS: web mapping services, Plotting points on images and generating coordinates from them , Map box, WMS map, LOD Expressions, Aggregation and Replication using LOD, Nested LOD expressions and Levels of details, Parameters in detailed Parameters in calculations, Using parameters with filters, Column selection parameters, Chart selection parameters, Parameters in the reference line. Create Map Project using Tableau, Handle Unidentified/Unrecognized Locations in map. Tableau project using Parameters

UNIT – III   Advanced Visual Analytics   9 Hours

Histogram, Single axes graph, Dual axes graphs, Box plot, Funnel Chart, Waterfall Chart, Pareto Chart, Tree Map, Heat Map, Market Basket Analysis (MBA), MBA with Example, Dashboards and its relevance, Building a Dashboard, Interactive Dashboard, Action Based Dashboard, Formatting, Dashboard, Legends and Highlights in Dashboards, Explore the problem statement and find insights using appropriate charts, Explore MBA scenario using Tableau, Create first dashboard and use action.

UNIT – IV   Story Dashboard   **9 Hours**

Create a Story, Adding Story Points, Understanding Story Points, Formatting Story, Visualizations in Story, Adding Annotations and Captions in Story and Dashboards, Relevance of Description points, Actions in Dashboard and Story, Highlight Actions, URL Actions, Filter Actions, Best Practices in Dashboard, Best Practices in Story, Joins in Detail, Joining different sources, Data blending, Publishing Data source. Create the first story board, Using problem statement create a story to identify insights, Create a Data source and Publish in tableau public

UNIT - V   Creative Dashboards   **9 Hours**

Creating Dashboards for device, Dashboard for Mobile device, Tableau Architecture, Tableau Server, What is VizQL, Relevance of VizQL, Tableau Online, Publishing Workbook, Data Management, AI in Tableau Online, Ask Data, Explain Data, Introduction to Tableau Prep, Combine join, shape, and clean data for analysis, Examples with Tableau Prep, Examples with Tableau Prep, Introduction to Data Analysis using Prep, Create a analytic Workflow. Create a dashboard for different devices, Explore free Trial on Tableau Online, Create your analytic workflow using prep and connect to tableau

Course Outcomes:

At the end of this course, learners will be able to:

- visualize the various forms of data to understanding
- picturize data through various maps and Level of Details
- plot different graphs and reveal the insights of the data
- envisage the problem statement by creating stories and dashboards
- create dashboards, perform data management and perform data analytics with prep

Textbooks:

1. Alexander Loth (2019), Visual Analytics with Tableau, Wiley
2. Marlin Meir, Mastering Tableau 2023 - Fourth Edition: Implement advanced business intelligence techniques, analytics, and machine learning models with Tableau

Reference Books:

1. Ryan Sleeper (2018). Practical Tableau: 100 Tips, Tutorials, and Strategies from a Tableau Zen Master
2. Business Information Visualization by Tegarden, D. P.. Communications of the AIS, 1(4): 1-38.1999.
3. Visual Representation: Implications for Decision Making by Lurie, N.H. and C.H. Mason. Journal of Marketing, 71(1): 160-177. 2007

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M.Tech. - II Semester CSE(DS)

25BDS17	**Artificial Intelligence and Deep Learning** Program Elective Course - IV	L	T	P	C
		3	0	0	3

Course Objectives:

- To understand the Fundamentals of Deep Learning
- To understand deep learning techniques such as convolutional neural networks (CNNs)
- To understand deep learning techniques such as recurrent neural networks (RNNs)
- To understand generative models such as generative adversarial networks (GANs), variational autoencoders (VAEs), and transformers.
- To evaluate and optimize deep learning models

UNIT – I Introduction to Deep Learning   **10 Hours**

Introduction to Neural Networks + Deep Learning - Basics of Artificial Neuron - Architecture of Neural networks - Forward Propagation - Backpropagation and Optimization - Loss Functions - Regularization Techniques - Training Deep Neural networks - Lab : Practical implementation of training DNN - Neural Networks in Computer Vision - NLP with Neural Networks - Audio and Speech Processing - Reinforcement Learning with Neural networks - Financial Predictions - Healthcare and Medical Imaging - Anomaly Detection in Industry - Linear Algebra for Neural Networks - Calculus and Statistics in Neural networks - Probability and Statistics - Optimization Techniques - Discrete Mathematics - Advanced Mathematical Concepts - Introduction to Tensor Flow - Lab : Building models with TensorFlow - Introduction to PyTorch - Lab : Building models with PyTorch - Introduction to Keras - Comparative study of Deep Learning Frameworks.

UNIT – II   Convolutional Neural Networks   **10 Hours**

Introduction to Convolutional Layers - Pooling Layers - Activation Functions in CNNs - CNN Architecture - Overfitting and generalization in CNNs - Practical Applications of CNN - Early CNN Models - AlexNet and the Breakthrough of CNNs - VGGNet: Simplification and Depth - GoogleNet - ResNet (residual Learning) - Advanced architectures and trends - Setting up the development environment - Data processing for CNNs - Lab : Building CNN models - Training and fine-tuning CNNs - Evaluation and Optimization of CNNs - Deploying CNN models - Understanding Gradient descent - Advanced Optimizers - Regularization Techniques - Hyperparameter Tuning - Learning Rate Schedules - Momentum and adaptive learning techniques - CNNs in Medical image Analysis - Autonomous Vehicles and Robotics - Video Analysis and Event Detection - Augmented and Virtual reality - Advanced Object detection and Image Segmentation - CNNs for Natural Disaster and Climate Analysis.

UNIT - III   Recurrent Neural Networks   **9 Hours**

Fundamentals of RNNs - Challenges in Training RNNs - Applications of Basic RNN - Types of RNN Architecture - Introduction to Long Short-Term Memory Networks - Long Short-Term Memory Networks (LSTM) - Gated recurrent Units (GRUs) - Bidirectional RNNs - Attention Mechanisms in RNNs - Advanced Applications of RNN Variants - Development Environment Setup for RNNs - Lab : Building and Training Basic RNNs - Lab : Implementing LSTM and GRUs - Optimization and regularization of RNNs - Advanced techniques in RNN Architecture - Deploying RNN Models - Diagnosing RNN Performance Issues - Advanced Gradient techniques - Hyperparameter Tuning for RNNs - Regularization Strategies for RNNs - Troubleshooting deployment issues - Ensuring model robustness and scalability - Text generation and Natural Language Processing - Financial Time Series Predictions - Health Monitoring and Medical Diagnosis - Speech Recognition and Voice Activated Systems - Video Content Analysis and Surveillance.

UNIT – IV   Improving DL Networks   9 Hours

Bias & Variance – Regularization- Overfitting – Dropout regularization – data augmentation – Normalizing inputs – exploding gradients – derivative computation – gradient checking – gradient descent – exponentially weighted average– optimization algorithms – hyperparameter and its tuning – batch normalization- multiclass classification – DL framework.

UNIT – V   Machine Learning Projects   7 Hours

ML strategy, Orthogonalization - Metrics and classifications - distributors - data sets - Bias and variance - Human level performance - Model performance - error analysis - Training and testing - mismatched data distributions - Transfer learning - multi-task learning - end-to-end deep learning

Course Outcomes:

At the end of this course, learners will be able to:

- Understand the fundamental concepts of neural networks, including architectures, training algorithms, and optimization techniques.
- Understand deep learning techniques such as convolutional neural networks (CNNs), recurrent neural networks (RNNs)
- Understand generative models such as generative adversarial networks (GANs), variational autoencoders (VAEs), and transformers.
- Understand principles and strategies for prompt engineering, including designing effective prompts, controlling model behavior, and mitigating biases.
- Ability to evaluate and optimize deep learning models

Textbooks:

1. Charu C. Aggarwal, Neural Networks and Deep Learning, Springer International Publishing AG, 2023.
2. J Lavika Goel, Artificial Intelligence: Concepts and Applications, Wiley, 2021.

Reference Books:

1. James D. Hamilton, Time Series Analysis, Levant Books, 2012. 2. Stan Z. Li & Anil K. Jain, Handbook of Face Recognition Second Edition. Springer-Verlag, 2004.

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M.Tech. - II Semester CSE(DS)

25BDS18	DATA ANALYTICS LAB	L	T	P	C
		0	0	4	2

Course Objectives:

- Understand and analyze how information theory, similarity score and Probability theory can be used to build prediction models.

Indicative Experiments:

1. Find the statistical measures of central tendency and dispersion such as min(), max(), mean(), median (), quantile(), sd() ,var() and summary() for real world datasets.

2. Demonstrate the different data visualization techniques. (Scatter Plot, Horizontal Bar Chart, Histogram, Visualization of Time Series data (Line Graphs) for applications such as weather analysis.

3. Perform the chi-square test and ANOVA F-test on datasets.

4. Implement the PCA method for dimensionality reduction on datasets.

5. Implement the RFE method and show the importance of features

6. Implement the Decision Tree for given datasets and compute the accuracy of model.

7. Implement the K-Nearest Neighbor Algorithm for given datasets and analyze the results.

8. Implement the Naïve Bayes method.

9. Implement simple linear regression program to predict the future values and analyze the goodness of fit.

10. Implement multivariate linear regression program to predict the future values analyze the goodness of fit.

11. Implementation of Distributed Decision Trees

Course Outcomes:

Upon completion of the course the student will be able to
- Analyze the different data preprocessing techniques.
- Apply the prediction model for decision making for a given set of problems.
- Apply regression algorithms for finding relationships between data variables

Textbooks:

1. John D. Kelleher, Brian Mac Namee, Aoife D'Arcy -Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, MIT Press 2020, 2nd Edition.

Reference Books:

1. Jason Brownlee -Data Preparation for Machine Learning: Data Cleaning, Feature Selection, and Data Transforms in Python, First Edition, 2020.
2. Guanhua Wang-Distributed Machine Learning with Python, Packt Publishing, 2022

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M.Tech. - II Semester CSE(DS)

25BDS19	BIG DATA FRAMEWORKS AND TECHNOLOGIES LAB	L	T	P	C
		0	0	4	2

Course Objectives:

- To understand the need for a framework to store and process big data.
- To have knowledge of Big Data Technologies for processing Different types of Data.
- To understand the advanced framework for faster accessing and processing of Big Data.

Indicative Experiments:

1. Installing and configuring the Hadoop framework. HDFS Commands,
2. Map Reduce Program to show the need of a combiner
3. Map Reduce I/O Formats – Text, Key–Value
4. Map Reduce I/O Formats – NLine – Multiline
5. Installing and Configuring Apache PIG and HIVE
6. Sequence File Input / Output Formats
7. Distributed Cache & Map side Join, Reduce Side Join
8. Building and Running Spark Application
9. Word count in Hadoop and Spark
10. Manipulation RDD
11. Spark Implementation of Matrix algorithms in Spark Spark Sql
12. programming, Building Spark Streaming application

Course Outcomes:

- Implement and evaluate the data manipulation procedures using Pig, Hive and Spark on the Hadoop framework.

Reference Books:

1. Mike Frampton "Mastering Apache Spark" – Pract Publishing 2015
2. Tom White, "Hadoop – The Definitive Guide", O'Relly 4th Edition 2015
3. Nick Pentreath, "Machine Learning with Spark" Pract Publishing 2015
4. Mohammed Gulle, "Big Data Analytics with Spark: A Practitioner's Guide to Using Spark for Large Scale Data Analysis" – Apress 2015
5. Adam Shook and Donald Mine, "MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems" - O'Reilly 2012

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M.Tech. - II Semester CSE(DS)

25BDS20	TECHNICAL SEMINAR	L	T	P	C
		2	0	0	2

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M.Tech. - II Semester CSE(DS)

25BMB03	PEDAGOGY STUDIES Audit Course - II	L	T	P	C
		2	0	0	0

Course Objectives:

- Review existing evidence on the review topic to inform programmed design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT - I   **9 Hours**

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education. Conceptual Framework, Research questions**.** Overview of methodology and searching.

UNIT - II   **9 Hours**

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT – III   **9 Hours**

Evidence on the effectiveness of pedagogical practices, Methodology for the in-depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT – IV   **9 Hours**

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher, and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes

UNIT – V   **9 Hours**

Research gaps and future directions: Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

Course Outcomes:

At the end of this course, students will be able to understand:

- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

Textbooks:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal of Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass-scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

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M.Tech. - II Semester CSE(DS)

25BMB04	STRESS MANAGEMENT BY YOGA Audit Course - II	L	T	P	C
		2	0	0	0

Course Objectives:

- To achieve overall health of body and mind
- To overcome stress

UNIT - I

Definitions of eight parts of yoga. (Ashtanga)

UNIT - II

Yam and Niyam.

UNIT - III

Do`s and Don'ts in life.
  i)   Ahinsa, satya, astheya, bramhacharya, and aparigraha
  ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT - IV

Asan and Pranayam

UNIT - V

 i) Various yoga poses and their benefits for the mind &body
 ii) Regularization of breathing techniques and their effects-Types of Pranayam

Course Outcomes:

At the end of this course, students will be able to

- Develop a healthy mind in a healthy body, thus improving social health also
- Improve efficiency

Textbooks:

1. Yogic Asanas for Group Training - Part I": Janardan Swami Yoga Bhyasi Mandal, Nagpur
2. "Raja yoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

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M.Tech. - II Semester CSE(DS)

25BHS05	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS Audit Course - II	L	T	P	C
		2	0	0	0

Course Objectives:

- To learn to achieve the highest goal happily
- To become a person with a stable mind, pleasing personality, and determination
- To awaken wisdom in students

UNIT - I

Neetisatakam - Holistic development of personality
Verses -19, 20, 21, 22 (wisdom)
Verses - 29, 31, 32 (pride &heroism)
Verses – 26, 28, 63, 65 (virtue)

UNIT - II

Neetisatakam - Holistic development of personality
Verses - 52, 53, 59 (don'ts)
Verses - 71, 73, 75, 78 (do's)

UNIT - III

Approach to day-to-day work and duties.
Shrimad Bhagwad Geeta: Chapter 2 - Verses 41, 47, 48,
Chapter 3 – Verses 13, 21, 27, 35, Chapter 6 - Verses 5, 13, 17, 23, 35,
Chapter18 – Verses 45, 46, 48.

UNIT - IV

Statements of basic knowledge.
Shrimad Bhagwad Geeta: Chapter 2 - Verses 56, 62, 68
Chapter 12 -Verses13, 14, 15, 16, 17, 18
Personality of Role Model. Shrimad Bhagwad Geeta:

UNIT - V

Chapter 2 - Verses 17, Chapter 3 – Verses 36, 37, 42,
Chapter 4 - Verses18, 38, 39
Chapter 18 – Verses 37, 38, 63

Course Outcomes:

At the end of this course, students will be able to

- Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing a versatile personality of students

Textbooks:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Threeatakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

M.Tech. - III Semester CSE(DS)

25BDS21	DATA SCIENCE IN BIOINFORMATICS Program Elective Course – V	L	T	P	C
		3	0	0	3

Course Objectives:

- To provide exposure to Data Science within the context of its importance in biology.
- To learn various methodologies and techniques in biology using Data Science.
- To learn various tools for bioinformatics data analytics.
- To learn deep learning approaches for bioinformatics applications.
- To learn and apply various data science models in biology.

UNIT - I   **9 Hours**

Need for Data Science in Biology and Healthcare, Visualization tools for biological and bioinformatics datasets, data handling, transformations of data.

UNIT - II   **9 Hours**

Data Science in genomics, from genetics to genomes, Alignment, and phylogenetic trees.

UNIT - III   **9 Hours**

Structural bioinformatics, Proteomics, Protein structure prediction, integrative structural modeling, and structure-based drug design.

UNIT - IV   **9 Hours**

AI algorithms, statistical tools, graph algorithms for bioinformatics data analytics.

UNIT - V   **9 Hours**

Deep learning algorithms in perspective of bioinformatics applications, GANs for biological applications, Whole-cell modeling approaches.

Course Outcomes:

At the end of this course, learners will be able to:

- understand the importance of Data Science in biology.
- acquire knowledge of different data science techniques in biology.
- Learn and apply various tools for bioinformatics data analytics.
- Learn and applying deep learning approaches for bioinformatics applications.
- To acquire knowledge on various data science models in biology.

Textbooks:

1. Arthur M. Lesk, "Introduction to Bioinformatics", Oxford University Press) (Fifth Edition)
2. Jeil Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media Inc. (Second Edition,)
3. Vince Buffalo, "Bioinformatics Data skills", O'Reilly Media Inc.
4. Neil C. Jones and Pavel A. Pevzner, "An introduction to Bioinformatics Algorithms", The MIT Press.

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M.Tech. - III Semester CSE(DS)

25BDS22	REINFORCEMENT LEARNING Program Elective Course - V	L	T	P	C
		3	0	0	3

Course Objectives:

* Reinforcement Learning is a subfield of Machine Learning, but is also a general-purpose formalism for automated decision-making and AI. This course introduces you to statistical learning techniques where an agent explicitly takes actions and interacts with the world.

UNIT – I   **9 Hours**

Introduction: Introduction to Reinforcement Learning (RL) – Difference between RL and Supervised Learning, RL and Unsupervised Learning. Elements of RL, Markov property, Markov chains, Markov reward process (MRP).

UNIT – II   **9 Hours**

Evaluative Feedback - Multi-Arm Bandit Problem: An n-Armed Bandit Problem, Exploration vs Exploitation principles, Action value methods, Incremental Implementation, tracking a non-stationary problem, optimistic initial values, upper-confidence-bound action selection, Gradient Bandits. Introduction to and proof of Bellman equations for MRPs

UNIT - III

Introduction to Markov decision process (MDP), state and action value functions, Bellman expectation equations, optimality of value functions and policies, Bellman optimality equations. Dynamic Programming (DP): Overview of dynamic programming for MDP, principle of optimality, Policy Evaluation, Policy Improvement, policy iteration, value iteration, asynchronous DP, Generalized Policy Iteration.

UNIT - IV

Monte Carlo Methods for Prediction and Control: Overview of Monte Carlo methods for model free RL, Monte Carlo Prediction, Monte Carlo estimation of action values, Monto Carlo Control, On policy and off policy learning, Importance sampling. Temporal Difference Methods: TD Prediction, Optimality of TD(0), TD Control methods - SARSA, Q-Learning and their variants.

UNIT - V

Eligibility traces: n-Step TD Prediction, Forward and Backward view of TD(λ), Equivalence of forward and backward view, Sarsa(λ), Watkins's Q(λ), Off policy eligibility traces using

importance of sampling. Function Approximation Methods: Value prediction with function approximation, gradient descent methods, Linear methods, control with function approximation.

Course Outcomes (CO):

At the end of this course, learners will be able to:
- Formulate Reinforcement Learning problems
- Apply various Tabular Solution Methods to Markov Reward Process Problems
- Apply various Iterative Solution methods to Markov Decision Process Problems
- Comprehend Function approximation methods

Textbooks:
1. Richard S. Sutton and Andrew G. Barto, Reinforcement Learning: An Introduction", 2nd Edition, The MIT Press.
2. CsabaSzepesvari – Algorithms for Reinforcement Learning – Morgan & Claypool, 2010.

Reference Books:

1. Reinforcement Learning By Richard S. (University Of Alberta) Sutton, Andrew G. (Co-Director Autonomous Learning Laboratory) Barto

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M.Tech. - III Semester CSE(DS)

25BDS23	DATA SCIENCE FOR DECISION MAKING Program Elective Course - V	L	T	P	C
		3	0	0	3

Course Objectives:

- To learn the concept of data-driven decision-making.
- To learn basic data analysis.
- To learn various issues of the design of data-driven experiments.
- To understand and application of decision-making tools.
- To learn and apply statistical analysis on data.

UNIT - I   9 Hours

Fundamentals of Analytics: Introduction to data-driven decision making; general introduction to data driven strategy and its importance; use of examples and mini-case studies to illustrate the role of statistical analysis in decision making.

UNIT - II   9 Hours

Basic Data Analysis: Various types of data that are commonly collected by firms; methods to be used and inferences/insights that can be obtained depending on the type of data that are available (stated versus revealed preference, level of aggregation, cross- sectional, time series, panel data and so forth); use of frequency distributions, mean comparisons, and cross tabulation; statistical inferences using chi-square; t-test and ANOVA.

UNIT - III   9 Hours

Experimental Design and Natural Experiments: Issues of design of experiments and internal and external validity; case studies in marketing; economics; and medicine etc.; A-B testing; and circumstances that provide us with "natural" experiments.

UNIT - IV   9 Hours

Decision making tools: Regression analysis and its applications; use of regression output in forecasting; promotional planning and optimal pricing; multivariate analysis (unsupervised learning) cluster analysis; factor analysis decision trees; elastic nets and random forests.

UNIT - V   9 Hours

Case Studies: To understand the problem at an intuitive level; use of simple data analysis and visualization to verify (or falsify) the intuition; use of appropriate statistical analysis to present your arguments.

Course Outcomes:

At the end of this course, learners will be able to:

- Understanding the concept of data driven decision making.
- To acquire the knowledge of basic data analysis.
- Able to run data driven experiments and design.
- Able to apply decision making tools.
- Understand and apply statistical analysis on data

Textbooks:

1. F.S. Hillier and G.J. Liberman "Introduction to Operations Research" Tata McGrawHill Education Private Limited.
2. Gregory S. Parnel, Terry A. Bresnick, Steven N. Tani, Eric R. Johnson "Handbook of Decision Analysis", Wiley.
3. Emily Moberg and Igor Linkov "Multi-Criteria Decision Analysis: Environmental Applications and Case Studies", CRC Press, Taylor and Francis group.
4. Adiel Teixeira de Almeida, Emel Aktas, Sarah Ben Amor, João Luis de Miranda "Advanced Studies in Multi-Criteria Decision Making", CRC Press.

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M.Tech. - III Semester CSE(DS)

		L	T	P	C
25BCM28	**WASTE TO ENERGY** Open Elective	3	0	0	3

Course Objectives:

- Introduce and explain energy from waste, classification and devices to convert waste to energy.
- To impart knowledge on biomass pyrolysis, gasification, combustion and conversion process.
- To educate on biogas properties, bio energy system, biomass resources and their classification and biomass energy programme in India.

UNIT – I   **9 Hours**

Introduction to Energy from Waste: Classification of waste as fuel – Agro-based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

UNIT – II   **9 Hours**

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT – III   **9 Hours**

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation

UNIT – IV   **9 Hours**

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT – V   **9 Hours**

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification- pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Course Outcomes:

After the completion of the course, students will be able to
- To know about the overview of Energy to waste and the classification of waste.
- To acquire knowledge on biomass pyrolysis, gasification, combustion and conversion process in detail.
- To gain knowledge on properties of biogas, biomass resources and programmes to convert waste to energy in India.

Textbooks:

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 2018
2. Biogas Technology - A Practical Handbook - Khandelwal, K. C. and Mahdi, S. S., TMH, 2017

Reference Books:

1. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996

Online Learning Resources:

1. **https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-ch13/**
2. **https://www.youtube.com/watch?v=x2KmjbCvKTk**

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M.Tech. - III Semester CSE(DS)

25BMB04	BUSINESS ANALYTICS Open Elective	L	T	P	C
		3	0	0	3

Course Objectives:

- The main objective of this course is to give the student a comprehensive understanding of business analytics methods.

UNIT – I   **9 Hours**

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst.
Stakeholders: the project team, management, and the front line, Handling Stakeholder Conflicts.

UNIT – II   **9 Hours**

Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

UNIT – III   **9 Hours**

Forming Requirements: Overview of Requirements, Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents. Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

UNIT – IV   **9 Hours**

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements. Managing Requirements Assets: Change Control, Requirements Tools

UNIT – V   **9 Hours**

Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

Course Outcomes:

At the end of this course, learners will be able to:

- demonstrate knowledge of data analytics.
- demonstrate the ability of think critically in making decisions based on data and deep analytics.

- demonstrate the ability to use technical skills in predictive and prescriptive modeling to support business decision-making.
- Students will demonstrate the ability to translate data into clear, actionable insights.

Textbooks:

1. Business Analysis by James Cadle et al.
2. Project Management: The Managerial Process by Erik Larson and, Clifford Gray

Reference Books:

1. Business Analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, Pearson Education.

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M.Tech. - III Semester CSE(DS)

25BDS24	CYBER SECURITY Open Elective	L	T	P	C
		3	0	0	3

Course Objectives:

- To learn about cyber crimes and how they are planned
- To learn the vulnerabilities of mobile and wireless devices
- To learn about the crimes in mobile and wireless devices

UNIT - I   **9 Hours**

Introduction to Cybercrime: Introduction, Cybercrime and Information security, who are cybercriminals, Classifications of Cybercrimes, Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

UNIT – II   **9 Hours**

Cyber offenses: How criminals Plan Them Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

UNIT – III   **9 Hours**

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile.

UNIT - IV   **9 Hours**

Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks

UNIT - V   **9 Hours**

Understanding Computer Forensics: Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital Evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Chain of Custody concept, Network Forensics, Approaching a computer, Forensics Investigation, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing.

Course Outcomes:

At the end of this course, learners will be able to:

- Explain the fundamental concepts of cybercrime, types of cybercriminals, and legal frameworks, including the Indian ITA 2000 and global perspectives.
- Analyze various cyber offenses such as social engineering, cyberstalking, botnets, and attacks in cloud environments.
- Assess the security threats and challenges associated with mobile and wireless devices, and recommend preventive measures.
- Demonstrate knowledge of various tools, techniques, and attack vectors used in cybercrimes, including malware, phishing, DoS/DDoS, and SQL injection.
- Describe the principles and lifecycle of digital forensics, including evidence collection, analysis, and investigation procedures.
- Apply digital forensic tools and techniques to investigate network intrusions and ensure evidence integrity using proper chain of custody protocols.

Textbooks:

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure, Wiley INDIA.
2. Introduction to Cyber Security, Chwan-Hwa(john) Wu, J. David Irwin. CRC Press T&F Group

Reference Books:

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.