Sanjay Ghodawat University

Kolhapur

School of Technology

Department of Computer Science and Engineering

M. Tech. Artificial Intelligence & Data Science

Syllabus

(Programme Structure and Course Contents)

Academic Year 2021 - 22

Sanjay Ghodawat University (SGU) is established in the Academic Year 2017-18, as a State Private University under Govt. of Maharashtra Act No. XL of 2017 dated 3rd May 2017, with the approval of the UGC and the state Government. "For the true measure of giving is giving without measure." Spread across 150 Acres, Sou. SushilaDanchandGhodawat Charitable Trust's Sanjay Ghodawat University (SGU) is situated in serene atmosphere amidst idyllic hills and lush green meadows to study in harmony with Nature. The Institution aspires to run along the lines of best-in- the-world education and become a world-class institution where teaching-learning process gets a far deeper meaning. SGU always stands as the guiding star of brilliance, quality and deliverance beyond expectations. Innovativeness and Creativity are the hallmarks of a genius enterprise and SGU stands to be a stage where these qualities would be nurtured, encouraged and blossomed. The genius is incomplete without the sense of social responsibility and SGU's ultimate goal remains the development of an attitude of gratitude that freely gives back without expectations.

The Sanjay Ghodawat University stands as a beacon of light to guide the younger generation of the day on the right path to fulfilment in career and life. The USP of the University is its research based curriculum and academically oriented teaching staff. The world class ambience and infrastructure helps the students to easily accommodate themselves in an environment that is conducive to the teaching- learning process. Hands on experience, challenge based case studies, maximum participation of students in the classroom, use of modern digital technology, smart classrooms, solution oriented thinking promotion, stress on research and innovation, international tie ups, choice based credit system for flexibility in choosing areas of interest etc. are some of the features of the University.

The university will help students develop as a unique individual-to be educated as a whole person, intellectually, emotionally, socially, ethically, and spiritually. The educational program designs are worked out meticulously in line with best in class universities with special focus on:

- Flexible Choice Based Credit System
- OBE - Outcome Based Education System
- Experiential Learning
- Project Based Learning
- Case Based Learning
- Training need analysis based on Performance Appraisal System
- Active Learning tools for effective delivery
- Mentoring / Proctorship
- On line learning /Self learning platforms
- Flipped Classroom concept
- Effective Student Feedback Mechanism

Vision

Internationally recognized university of excellence in creating and disseminating knowledge through value-based quality education leading to betterment of mankind.

Mission

- To prepare students for life-long learning and leadership in a global academic culture
- To create intellectual manpower relevant to the industry and society at large
- To collaborate with institutions of international repute for academic excellence
- To promote research and development through conducive environment
- To encourage entrepreneurship and skill development programs

Core Values

- Integrity
- Transparency
- Accountability
- Equality
- Empathy
- Stewardship

Quality Policy

Sanjay Ghodawat University is committed to establish high standards in value-based quality education to enhance and nurture young minds to excel in their chosen profession and develop into socially responsible citizens through resourceful collaboration, innovation and research

Choice Based Credit System (CBCS)

The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice based credit system provides a ‘cafeteria’ type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, and adopt an interdisciplinary approach to learning.

University Grants Commission has come up with the Choice Based Credit System (CBCS) programme in which the students have a choice to choose from the prescribed courses, which are referred as core, elective or minor or soft skill courses and they can learn at their own pace and the entire assessment is graded-based on a credit system. The basic idea is to look into the needs of the students so as to keep up-to-date with development of higher education in India and abroad. CBCS aims to redefine the curriculum keeping pace with the liberalization and globalization in education. CBCS allows students an easy mode of mobility to various educational institutions spread across the world along with the facility of transfer of credits earned by students.

Where the students can choose the prescribed courses, as the core, and elective or soft skill courses, from a range of options, rather than to simply consume what the curriculum offers. They can learn at their own pace and the assessments are graded based on a credit system. It provides an opportunity for students to have a choice of courses or subjects within a programmed resembling a buffet, against the mostly fixed set of subjects now being offered (except for the limited choice of electives in professional degrees and postgraduate programmers) with the flexibility to complete the programmed by earning the required number of credits at a pace decided by the students.

The UGC has always initiated measures to bring efficiency and excellence in the Higher Education System of India. The basic motive is to expand academic quality in all aspects, right from the curriculum to the learning-teaching process to examination and evaluation systems. However, so far multiple methods are followed by different universities across the country towards examination, evaluation and grading system. Considering this diversity, the implementation of the choice based credit system seems to be a good system in assessing the overall performance of a student in a universal way of a single grading system.

Outcome Based Education (OBE) Model

Sanjay Ghodawat University (SGU) has implemented OBE model of education, which is a learner centered approach. SGU has witnessed a sea change in the entire academic systems with implementation of all three components of OBE – Design, Delivery and Assessment. The SGU model of autonomy focuses on experiential learning which believes in learning by doing. This is achieved through hands on experience, industrial assignments, mini projects and live problem solving and collaboration with industries.

SGU is set in to dynamics of transformation and witnessing a shift in focus from teaching to learning and entire academic system of SGU is designed to provide multiple learning opportunities for students to acquire and demonstrate the Knowledge, Skills and Attitudes (KSA) for rewarding career.

The Vision and Mission of the Management, contribution from eminent BOG members and knowledgeable members of Academic Council and Board of Studies, the motivation and drive of the Director, the relentless efforts of the fellow Deans and Head of Departments and all teaching and non-teaching staff along with commitment to learning of students made it possible to successfully transform the institute and stand out to carve a niche for itself as an Institute of repute.

OBE is an approach of curriculum design and teaching that focuses on what students should be able to do (attained) at the end of course/ program. Outcome based education (OBE) is student-centered instruction model that focuses on measuring student performance through outcomes. Outcomes include knowledge, skills and attitudes (KSA). Its focus remains on evaluation of outcomes of the program by stating the knowledge, skill and behavior a graduate is expected to attain upon completion of a program and after 4 – 5 years of graduation. In the OBE model, the required knowledge and skill sets for a particular degree is

predetermined and the students are evaluated for all the required parameters (Outcomes) during the course of the program.

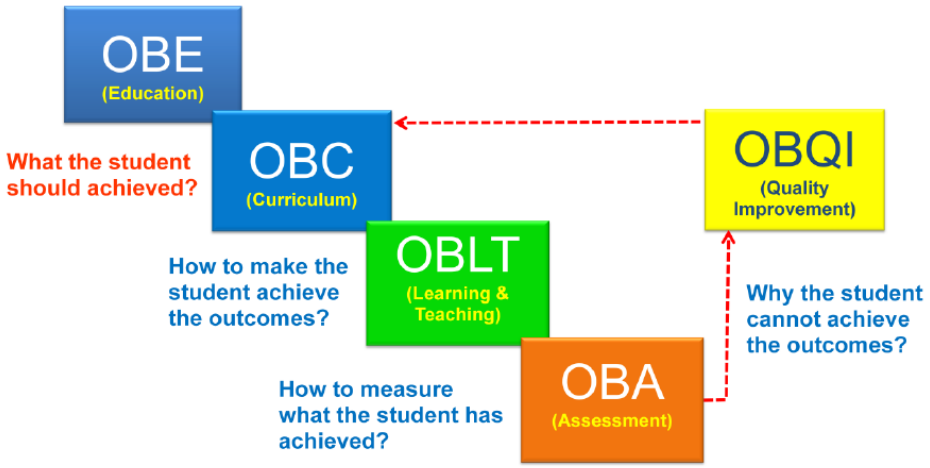
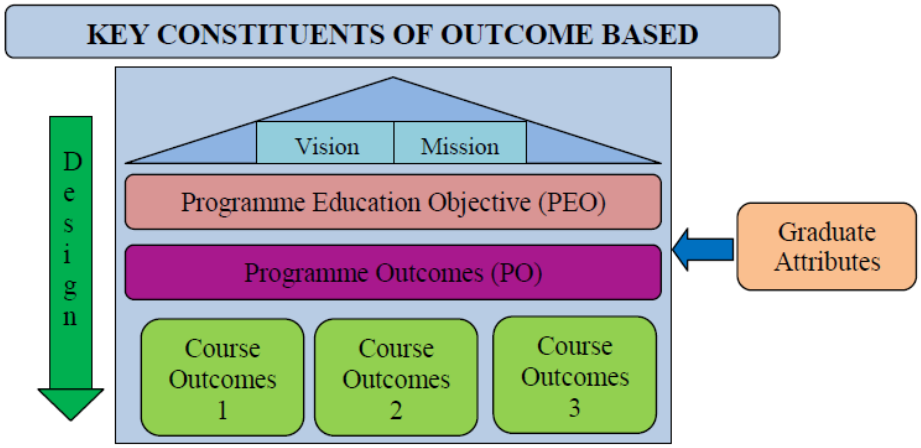


Figure 1: OBE flows and desciption



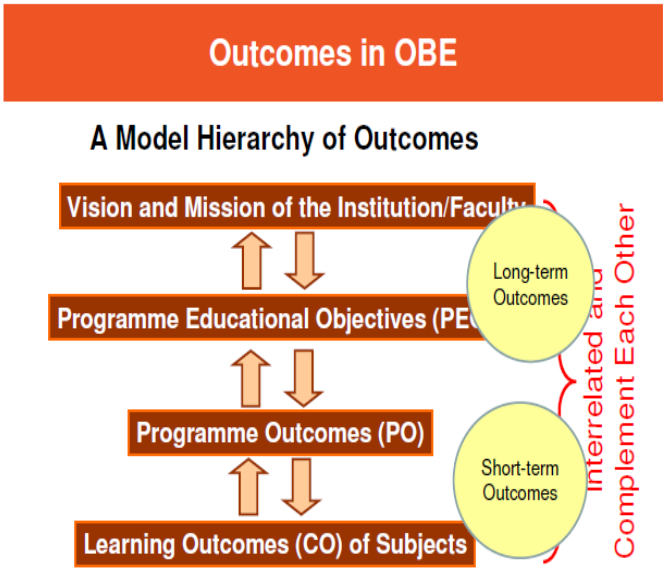
The OBE model measures the progress of the graduate in three parameters, which are

- Program Educational Objectives (PEO)
- Program Outcomes (PO)
- Course Outcomes (CO)

Program Educational Objectives (PEO) are broad statements that describe the career and professional accomplishments that the program is preparing the graduates to achieve. PEO's are measured 4-5 years after graduation. Program outcomes are narrower statements that describe what students are expected to know and be able to do by the time of graduation. They must reflect the Graduate attributes. Course outcomes are the measurable parameters

which evaluates each students performance for each course that the student undertakes in every semester.

The various assessment tools for measuring Course Outcomes include Tests and End Semester Examinations, Tutorials, Assignments, Project work, Labs, Presentations, Employer/Alumni Feedback etc. These course outcomes are mapped to Graduate attributes and Program outcomes based on relevance. This evaluation pattern helps Institutions to measure the Program Outcome. The Program Educational Objective is measure through Employer satisfaction survey (Yearly), Alumni survey (Yearly), Placement records and higher education records.



Special Features of OBE

- OBE is an educational process that focuses on what students **can do**or the **qualities** they should develop after they are taught.
- OBE involves the restructuring of curriculum, assessment and reporting practices in education to reflect the achievement of high order learning and mastery rather than accumulation of course credits.
- Both structures and curricula are designed to achieve those **capabilities** or **qualities**.
- Discourages traditional education approaches based on direct instruction of facts and standard methods.
- It requires that the students demonstrate that they have learnt the required skills and content.

Sanjay Ghodawat University Kolhapur

(Established as a State University under Government of Maharashtra Act No XL dated 3rd May 2017)

Academic and Examination Rules and Regulations

Approved in the second Academic Council Meeting held on 27th May, 2019 and to be implemented from academic year 2019-20. [Version R1]

Sanjay Ghodawat University Kolhapur

Kolhapur - Sangli Highway, A/p Atigre - 416 118,
Tal. - Hatkanangale, Dist. Kolhapur,
Maharashtra, India

(Implemented from Academic year 2019-20)

Academic and Examination Rules and Regulations

1.0 Preamble

The Sanjay Ghodawat University (SGU) stands as a beacon of light to guide the younger generation of the day on the right path to fulfillment in career and life. Outcome Based Education (OBE) model is adopted to enhance the effectiveness of teaching learning process and Credit Based semester system is implemented.

The focus of the University is its research based curriculum and academically oriented teaching staff. The world class ambience and infrastructure helps the students to easily accommodate themselves in an environment that is conducive to the teaching- learning process. Hands on experience, challenge based case studies, maximum participation of students in the classroom, use of modern digital technology, smart classrooms, solution oriented thinking promotion, stress on research and innovation, international tie ups, choice based credit system for flexibility in choosing areas of interest etc. are some of the features of the University.

Vision of SGU is internationally recognized university of excellence in creating and disseminating knowledge through value-based quality education leading to betterment of mankind. To achieve the vision SGU will develop state-of-the-art infrastructure that promotes conducive ambience promoting innovation and research. Create intellectual manpower relevant to the industry and society at large. Foster mutually beneficial partnership with alumni, industry and academia. Inculcate ethics and values to develop socially responsible citizens and promote entrepreneurship.

SGU is offering various programs through schools such as School of Technology, School of Commerce and Management, School of Sciences and School of Arts.

SGU has implemented the outcome based Education (OBE) system and Credit based Evaluation System in all the schools.

The rules and regulations mentioned in this document are applicable to all the Under Graduate (UG) and Post Graduate programs offered by the Sanjay Ghodawat University from the academic year 2018-19. The rules and regulations stated here under are subjected to revisions / refinements, updates and modifications and amendments by academic council (AC) from time to time and applicable to all batches including those already undergoing programs at different year and are binding on all stakeholders including students, faculty, parents and University authorities.

The academic programs of the University shall be governed by rules and regulations approved by the academic council from time to time. Academic council is the supreme and statutory academic body that governs all academic matters of the university and the decisions of the academic council are final and binding in the matters related to academics.

2.0 Definition of Terms

1. University: University means Sanjay Ghodawat University, Kolhapur
2. Academic Year: The period of the year during which students attend university for all academic activities, usually it starts from first of July and ends on 30th of June next year.
3. **Semester:** Academic Year is divided in to 2 parts called Semester, Odd Semester which starts from July and Even Semester which starts from January.
4. **Duration of Semester**: Total duration of semester is usually 20weeks per semester including instructions, examination and evaluation. Total instructional days are 90 per semester.
5. **Course:** It is a Subject that is in a semester. The course may consist of Theory/Practical/Project/Seminar during semester. Usually taught by instructor in a class. e.g. Physics, Chemistry, Engineering Mechanics, Workshop etc.
6. **Program:** Collection of Courses is called Program. B Tech in Mechanical Engineering,
7. M Tech in Civil Engineering, Bachelor of Business Administration. Bachelor of Science etc.
8. **Department:** Department is a unit of the school which offers one or more programs.
9. **Contact Hours:** Time of students in class/laboratory with instructor. Usually in the range of 26-30 Hrs/Week. For the purpose of uniformity one contact hour is measured as 60 minutes
10. **Academic Council (AC):** Means apex academic body governing the academic programs responsible for framing policy, rules and regulations.
11. **Board of Examination (BOE):** Central body responsible for framing policy, rules and regulations for Examination.
12. **Board of Studies (BOS):** Departmental academic body to govern the academics of programs (BOS) offered by department.

3.0 Curriculum:

3.1. Curriculum:

Every program has a prescribed structure which, in general,is known as Curriculum. It prescribes courses to be studied in each semester. The booklet containing courses structure along with detail syllabus for each course of each program is updated periodically and made available on the website.

3.2. Semesters:

SGU implements a credit based semester system. The academic year is divided into two regular semesters. The semesters that begin in July are known as Odd semester and the

semester that begin in January are known as Even semesters. Total duration of each semester is generally of 20 weeks including the period of examination, evaluation and grade declaration.

3.3. Course Credit System/Structure:

In general, a certain quantum of work measured in terms of credits is laid down as the requirement for a particular program. Calculation of number of creditsfor a course in any semester is as per Table 3.1

Table 3.1: Calculation of number of credits for a course

Sr. No.	Course	Credits
1	Lecture of 1 hour/week	**1**
2	Tutorial of 1 hour/week	**1**
3	Practical / Laboratory / Drawing/mini-project of two hours/ week	**1**
4	Seminar (1 hour per week)	**1**

There are mainly two types of courses- viz. Theory courses and Laboratory courses. Generally a theory course consists of Lecture hours (L) and Tutorial hours (T). Tutorial hours may not be assigned to a particular theory course if it has a separate laboratory course. Laboratory course consists of practical hours (P) for which a student works in a Laboratory/Drawing Hall/Workshop. The other courses required to be taken by a student include seminar, mini project, and project at various levels of the program.

A student shall earn credits for a particular course by fulfilling the minimum academic requirements for attendance and evaluation. No credits shall be awarded if a student satisfies the minimum attendance requirements but fails to meet minimum evaluation requirements.

The total number of credits required for completing a program shall be mentioned in the course structure. The total number of credits in a semester which a student registers shall generally be 20--25. The maximum number of credits per semester shall not exceed 30

3.4. Audit Course:

- A student may have to register for an audit course in a semester which could be institute requirement or department requirement.
- An audit course may include either a) a regular course required to be done as per structure or required as pre-requisite of any higher level course or b) the programmes like practical training, industry visits, societal activities etc.
- Audit course shall not carry any credits but shall be reflected in Grade Card as "PP"/"NP" depending upon the satisfactory performance in the semester evaluation as per the course curriculum structure.

4.0 Course Registration:

4.1. Every student must register for the courses that he/she wants to study for earning credits at the beginning of each semester on the prescribed dates announced from time to time and shall be mandatory for every student till he/she completes the program. Only after registration his/her name shall appear in the roll list of each of such courses.

4.2. Students shall be required to fill up a Course Registration Form which shall be made available to them by the Student section of Administration office after payment of required fees.

4.3. Registration, according to rules, should be carried out as per the schedule given in academic calendar. Late registration may be permitted only for valid reasons and on payment of late registration fees. In any case, registration must be completed before the prescribed last date for registration, failing which his/her studentship shall be liable to be cancelled. Students having dues outstanding towards the institute or hostel shall be permitted to register only after clearing such dues.

4.4. In-absentia registration may be allowed only in rare cases at the discretion of the Dean Academics and with prior permission.

4.5. For registration in an odd semester, the student must have earned all the credits of the pre-previous year and at least 75% credits of the previous year. For example, for registration of the 5^{th} semester courses (i.e. 3^{rd} year of program), a student must have earned all the credits of the first year and 75% credits of the second year. Similarly, for registration of the 7^{th} semester courses (i.e. 4^{th} year of program), a student must have earned all the credits of the second year and 75% credits of the third year. However, if 75% calculation turns out to be a mixed number (integer + fraction) then only the integer part of that number shall be considered for taking decision related with this clause.

4.6. A student registered in odd semester shall be eligible to register for the courses offered in the even semester of that year irrespective of his/her SGPI or the number of credits earned by him/her in that odd semester.

5.0 Lateral Entry for B Tech Programs

Post diploma students in engineering and B.Sc. Graduates can have lateral entry at third semester of the program. Such admissions are governed by the rules of regulatory bodies like AICTE New Delhi and Directorate of Technical Education Maharashtra state and Sanjay Ghodawat University for Admission criteria and shall undergo all academic requirements as specified by the Academic council.

Forsuch students there shall not be First Year Performance Index (FYPI). Semester Performance Index (SGPI) and Cumulative Performance Index (CGPI) shall be

calculated from the third semester onwards taking into consideration the courses undergone by them at Sanjay Ghodawat University Kolhapur.
Registration of the students not covered by the cases mentioned above shall be decided by the Academic Council. Such students shall undergo the academic program as specified by the Academic Council. Such odd entry students shall not be eligible for any medals or awards instituted by the institute.

6.0 Change of Program:

This is applicable to B Tech Program only. Students shall be eligible to apply for Change of Program after completing the first two semesters. The following rules/ guidelines shall be used for considering their applications for change:

6.1. The change of program shall be permitted strictly on merit basis subject to the rules of admissions prevailing at the time of such change.

6.2. Students without fail grades and/or backlogs shall be eligible to apply for change of programand can give their choices in the order of preference.

6.3. The request for change of program by a student from program A to program B shall be considered if number of students of program B does not exceed the sanctioned capacity of program B and also the minimum strength required to run the program as decided by Academic Council.

6.4. All such transfers can be effected only once at the beginning of the second academic year of the 4-year UG program. No application for change of program during subsequent academic years shall be entertained.

7.0 Facilitation to Students:

7.1. Faculty Advisor:

On joining the institute, a student or a group of students shall be assigned to a faculty advisor who shall be mentor for a student throughout his/her tenure in the institute. A student shall be expected to consult the faculty advisor on any matter relating to his/her academic performance and the courses he/she may take in various semesters / summer term. A faculty advisor shall be the person to whom the parents/guardians should contact for performance related issues of their ward. The role of a faculty advisor is as outlined below:

The role of the Faculty Adviser is outlined below:

a. Guide the students about the rules and regulations governing the courses of study for a particular degree.

b. Advise the students for registering courses as per curriculum given. For this purpose, the Faculty Adviser has to discuss with the student his/her academic performance during the previous semester and then decide the number and nature of the courses for which s/he can register during the semester as per the curriculum.

c. Approve the registration of the students.

d. Advice students to overload/ drop one or more courses/activities based on her/his academic performance as per the prescribed rules.
e. At the end of the first semester/year, the Faculty Adviser may even advise a reduced load program for a poorly performing student.
f. Pay special attention to weak students and carefully monitor performance of students recommended for slow track option.
g. Advice students for Course Adjustment / Dropping of courses during the Semester within the stipulated time frame given in the Academic calendar.
h. Advice students seeking semester drop either during the ongoing semester or before the commencement of the semester. FA has to ensure strict compliance of rules and regulations laid down for this purpose. Recommend the cases to the appropriate authorities for consideration.
i. Make revised plan of study for weak/bright students based on their semester wise performance.
j. Suggest modalities for course/credit requirements for the students recommended for exchange program.
k. Guidance and liaison with parents of students for their performance.
l. To ensure that students are not permitted to reregister for courses, which they have already passed.
m. Inform students that any academic activity (course / Lab. / seminar / project / noncredit requirement etc.) undergone without proper registration will not be counted towards the requirements of his/her degree.
n. Strictly warn students that if she/he fails to register during any semester without prior approval, his/her studentship is liable to be cancelled.
o. Keep the students updated about the Academic Administration of the University.

7.2. Helping Weaker Students:

A student with backlog/s should continuously seek help from his/her faculty advisor, Head of the Department and the Dean of respective schools. Additionally, he/she must also be in constant touch with his/her parents/local guardians for keeping them informed about academic performance. The university also shall communicate to the parents/guardians of such student at-least once during each semester regarding his/her performance in in-in various tests and examination and also about his/her attendance. It shall be expected that the parents/guardians too keep constant touch with the concerned faculty advisor or Head of the Department, and if necessary - the Dean of the respective school.

8.0 Discipline and Conduct:

8.1. Every student shall be required to observe discipline and decorous behavior both inside and outside the campus and not to indulge in any activity, which shall tend to bring down the prestige of the university.

8.2. Any act of indiscipline of a student reported to the Dean, Student Development, shall be discussed in a Disciplinary Action Committee of the institute. The Committee shall enquire into the charges and recommend suitable punishment if the charges are substantiated.

8.3. If a student while studying in the university is found indulging in anti-national activities contrary to the provisions of acts and laws enforced by Government he/she shall be liable to be expelled from the institute without any notice.

8.4. If a student is involved in any kind of ragging, the student shall be liable for strict action as per provisions in the Maharashtra anti-ragging act.

8.5. If any statement/information supplied by the student in connection with his/her admission is found to be false/ incorrect at any time, his/ her admission shall be cancelled and he/she shall be expelled from the university and fees paid shall be forfeited.

8.6. If a student is found guilty of malpractice in examinations then he/she shall be punished as per the recommendations of the Grievance Redressed Committee (CRC) constituted by Board of Examinations.

8.7. Every admitted student shall be issued photo identification (ID) card which must be retained by the student while he/she is registered at Sanjay Ghodawat University Kolhapur. The student must have valid ID card with him/her while in the University Campus.

8.8. Any student who alters or intentionally mutilates an ID card or who uses the ID card of another student or allows his/her ID card to be used by another, student shall be subjected to disciplinary action.

8.9. The valid ID card must be presented for identification purpose as and when demanded by authorities. Any student refusing to provide an ID card shall be subjected to disciplinary action.

8.10. Students should switch off the Mobiles during the Instructional hours and in the academic areas of university Building, Library, Reading room etc. Strict action will be taken if students do not adhere to this.

8.11. During the conduct of any Tests and Examination students must not bring their mobiles. A student in possession of the mobile whether in use or switched off condition will face disciplinary action and will be debarred from appearing for the Test / Examination.

9.0 Academic Calendar

The academic activities of the institute are regulated by Academic Calendar and is made available to the students/ faculty members and all other concerned in electronic form or hard copy. It shall be mandatory for students / faculty to strictly adhere to the academic calendar for completion of academic activities.

10.0 Attendance:

10.1. Regular 100% attendance is expected from all students for every registered course in lectures, tutorial, laboratory, projects, mini-projects and other courses mentioned in program curriculum. Hence, attendance is compulsory and shall be monitored during the semester rigorously. Students shall be informed at the end of every month if they are failing short of attendance requirements.

10.2. A Maximum of 25% absence for the attendance may be permitted only on valid grounds such as illness, death in family of blood relations (Father, Mother, Sister, andBrother) and any other emergency reason which is beyond the control of the student and shall be approved by the authorities in respective departments.

10.3. If a student fails to put up 75% attendance individually in each course, the student will be put under X grade category and student will be debarred form attending the End Semester Examination (ESE) and Re-Exam for that semester in that course. However, student has an option to re-register for the course whenever it is offered next time or he can appear for 100% examination for which he will be awarded two grade penalties. Student's FET, CAT1 and CAT2 marks are treated as null and void.

10.4. The maximum number of days of absence for students participating in Co-curricular activities /Sports/ Cultural events during a semester shall not exceed 10. Any waiver in this context shall be on the approval of the Academic council only after the recommendation by Dean Academics of the university. The HOD and Dean of the respective school shall report and recommend to Academic Academic council the cases of students not having 75% attendance as per the records of course instructor. After rigorously analyzing these cases AC may take a decision to debar such student from End-Semester Examination (ESE) for that course. Such a student shall re-register for that course as and when it is offered next. ISE and MSE evaluations of such a student for this course during regular semester shall be treated as null & void.

10.5. A student remaining absent during ESE of a course either on medical ground (Accident and/or hospitalization of a student) or any other emergency circumstances (death of immediate close relative i.e. father, mother, brother and sister) or due to representing University at university/state level in sports/co-curricular activities shall be treated as per the rules of Sec 12.6.2 and 11.1.2

The critical cases of absenteeism which are not covered by any of the above clauses shall be reported by concerned Head of Department to Academic dean and all such cases the decision of Academic council is final.

11.0 Modes of Assessment:

11.1. Assessment of Theory Courses:

11.1.1. A student shall be evaluated for his/her academic performance in a theory course through Faculty Evaluation Theory (FET), Continuous Assessment Tests (CAT1 and CAT2) and End Semester Examination (ESE).

11.1.2. The relative weightage for the theory courses having ESE shall be generally as shown in the Table 11.1.2

Table 11.1.2: Weightage for the theory courses in %

FET	CAT1	CAT2	ESE
20	15	15	50

The details of the weightage of each course shall be listed in the structures of each program.

11.1.3. FET shall be based on student's performance in assignments, quizzes, seminars, Course projects and field assignments, term papers, etc. The mode of FET shall be decided and announced by the Course Instructor at the beginning of the course.

11.1.4. CAT1 shall generally be of one hour duration for each course and shall be held as per the schedule declared in the Academic calendar for that Semester. The test will be based on first two units of the course.

11.1.5. CAT2 shall generally be of one hour duration for each course and shall be held as per the schedule declared in the Academic calendar for that semester based on unit 3 and unit 4 of the syllabus.

11.1.6. ESE is of three hours comprehensive examination having the weightage of 60% for unit 5 and 6 and 40% to unit 1 to unit 4. It is of 100 marks

11.1.7. All examinations and evaluations shall be compulsory. Credits for a course shall be awarded only if a student satisfies evaluation criteria and acquires the necessary minimum grade.

11.1.8. There shall be no re-examination for CAT1 and CAT2 of the courses having all the three components of evaluation viz. FET, CAT1 CAT2 and ESE. However, a student remaining absent for CAT1 and CAT2 for representing the institute in state level or university level sports/co-curricular activities (on prior recommendation and approval from) or on valid grounds such as illness, death in family or other emergency reason which is beyond control of

a student (on approval by the head of department and dean of respective school shall be considered for Make- up examinations.

11.1.9. A student remaining absent for ESE of a course either due to medical reason (Accident and/or hospitalization of a student) or other emergency circumstances (death of immediate close relative i.e. father, mother, brother and sister) or due to representing college at university/state level in sports/co-curricular activities shall be awarded with grade "I". Such a student shall be allowed to appear for make-up examination scheduled along with re-examinations of other courses. The student shall apply to COE with proper documentary evidence to appear for make-up examination. After make-up examination, a student shall be entitled to an appropriate grade as per Table I of Sec. 10.1.2 based on his/her performance during the regular semester and in make-up examination.

11.2. Assessment of Laboratory Courses:

The assessment of laboratory course shall be continuous and based on turn-by-turn supervision of the student's work and the quality of his/her work as prescribed through laboratory journals and his/her performance in viva-voce examinations uniformly distributed throughout the semester. Where ESE for the laboratory course is specified ESE shall be based on performing an experiment followed by an oral examination. The relative weightage for FEP and ESE for assessment of laboratory courses shall be 50% each for FEP and ESE and a minimum performance of 40% in both ISE and ESE separately shall be required to get the passing grade.

11.2.2. ESE for laboratory course shall normally be held before the ESE for theory courses and shall be conducted by a panel of examiners appointed by COE from the panel of experts approved by BOS. This activity shall be coordinated by Department Examination Coordinator (DEC) in consultation with HOD of the respective department.

11.2.3. Student failed in ESE of a laboratory course in a regular semester shall be eligible to appear for 100% examination conducted alongwith ESEs of laboratory courses of the subsequent semester. Such examination shall be fairly comprehensive (generally of 3 hours similar to POE i.e. Practical-Oral-Examinations) to properly judge his/her practical skill and theoretical knowledge for that laboratory course. He/She shall suffer one grade penalty.

12.0 The Grading System:

Absolute Grading System (AGS) is adopted based on absolute numerical marks obtained by the student during all stages of evaluation for a course.

12.1. Award of Grade (Regular Semester):

12.1.1. For every course registered by a student in a semester, he/she shall be assigned a grade based on his/her combined performance in all components of evaluation scheme of a course as per the structure. The grade indicates an assessment of the student's performance and shall be associated with equivalent number called a grade point.

12.1.2. The academic performance of a student shall be graded on a ten point scale. The Absolute Grading System is followed. Letter grades, the guidelines for conversion of marks to letter grades and their equivalent grade points are as given in Table 12.1.2

12.1.3. A student shall pass the course if he/she gets any grade in the range "O" to "P".

12.1.4. "FF" grade shall be awarded to a student in a course if he/she gets less than 40% marks jointly in the FET, CAT1, and CAT2 & ESE for a theory course and in PET & ESE for a laboratory course. A course shall then be eligible to apply for re-examination. A student failed in laboratory course shall be eligible to apply only for 100% examination conducted with the laboratory examinations of the subsequent semester. In both cases, a student has to suffer one grade penalty.

Table 12.1.2: Grade Table for Regular Semester

Marks Obtained	Grade Letter GL	Grade Point GP	Performance Description
90-100	O	10	Outstanding
80-89	A+	09	Excellent
70-79	A	08	Very Good
60-69	B+	07	Good
50-59	B	06	Above Average
45-49	C	05	Average
40-44	P	04	Pass
00-39	F	00	Fail
-	Ab	00	Absent
-	X	00	Detained (Failed)
-	Satisfactory	-	Pass in Non Credit Courses
-	Un Satisfactory	-	Failed in Non Credit Courses

13.0 Assignment of X Grade

Grade "X" in a regular course shall be given to a student if he/she falls in any of the following categories.

13.1. Student does not maintain the minimum 75% attendance in any of the theory or laboratory courses.

13.2. A student has not completed most of the Evaluations like FET, CAT1 and CAT2 due to non-medical reasons (for example when a student has missed all or most of the components of internal evaluation conducted by the instructor in that semester).

13.3. The performance of a student is less than 40% in FET, CAT1 and CAT2 Combined.

13.4. A student is guilty of any academic malpractice during semester (Such cases shall be dealt by Grievance Redressed and Discipline Committee).

In above four cases grade "X" shall be declared one week before ESE and intimated to the Academic Office and COE immediately thereafter. Such a student shall not be permitted to take the ESE of that course.

13.5. Grade "X" may be given to a student if

13.5.1. A student eligible for ESE remains absent for ESE of a course with no written intimation to Exam Cell within four days after the respective ESE is over.

13.5.2. A student is guilty of any academic malpractice during examination. (Such cases shall be dealt by Grievance Redressal Committee).

In 13.5.2 grade "X" in that course shall be declared after Grievance Redressed Committee confirms the academic malpractice.In above two cases when a student gets "X " grade in a course, then this shall be treated as "FF" for the purpose of calculation of Semester Performance Index (SGPI) and First Year Performance Index (FYPI) or Cumulative Performance Index (CGPI).

13.6. Following rules apply to the student who has obtained grade "X" in a regular semester:

13.6.1. A student obtaining grade "X" in a course in a regular semester or during examination shall be not be allowed to appear for End semester examination and also Re ESE conducted before the beginning of the next semester. His/her FET, CAT1 and CAT2 evaluations for all courses shall be treated as null and void. He/She needs to re-register for courses of that semester in the next academic year whenever they are offered and undergo all evaluations along with fresh regular students for which he will get one grade penalty.

13.6.2. Grade "I" shall be declared in a theory/laboratory course if a student has satisfactory performance FET, CAT1, CAT2 and has fulfilled the 75% attendance requirement, but has not appeared for ESE due to genuine reasons. Such students shall be eligible for the make-up examination of ESE only on medical grounds/valid reasons and on production of authentic medical certificate or other supporting document/s (as required by the University) to the COE within ten days after the respective examination is over. The application form with requisite amount of fees must be submitted to the Exam Cell before the last date of filling such application forms for make-up examinations. These examinations shall be

based on 100% syllabus and shall be scheduled before the commencement of the subsequent semester for theory courses and along with ESEs of laboratory courses of the subsequent semester. A student with "I" grade when appears for the make-up examination shall be eligible to obtain a regular performance grade ("O" to "F") as per Table 12.1.2 depending on his/her overall performance in FET, CAT1, CAT2 and make-up examination. If a student fails to appear for make-up examination too, a grade "XX" shall be awarded to him/her. Thus "I" is only a temporary grade and shall be replaced by a valid grade only after make-up examination.

13.6.3. There shall be a few audit courses as per the policies of the institute or as decided by DPC of respective program. The grade "PP" (Passed)/ "NP" (Not Passed) shall be awarded for such courses depending upon the performance of a student evaluated by the faculty in-charge. No grade points shall be associated with these grades and performance in these courses shall be not taken into account in the calculation of the performance indices (SGPI, CGPI). However, the award of the degree shall be subject to obtaining a "PP" grade in all such courses.

14.0 Award of Grades for Re-Examination:

14.1. A student who has obtained grade "F" in regular semester shall be eligible to appear for re-examination conducted before the commencement of the next regular semester. In such cases FET, CAT1 and CAT2 marks are carried forward and a student has to suffer one grade penalty

14.2. A student shall apply for re-examination before the last date of such application and shall appear for re-examination.

14.3. 50% weightage similar to ESE shall be given to re-examination and there is one grade penalty.

14.3.1. A student who has obtained "F" grade in ESE of a regular semester and has not availed re-examination option or a student who has obtained "F" grade in both ESE and re-examination shall be eligible to choose one of the two options below to clear his/her backlog:

- Re-registration for the next regular semester course whenever that course is offered.
- Appearing for ESE of the course when conducted,

A student detained in a regular semester due to either a) by obtaining "X" grade or b) by involvement in academic malpractice or c) by breaking the institute code of conduct and discipline can re-register for the course when offered next

14.4. Following rules apply for these cases:

14.4.1. In first case i.e. Re- registration the earlier performance of a student in all

the evaluations of that course shall be treated as null and void. The student has to undergo all the evaluations after re-registration.

14.4.2. Grades for Third and Subsequent attempts:

If A student opts for ESE or Re ESE who previously had obtained grade "F" in a course in two attempts, his/her FET, CAT1 and CAT2 performance of the regular semester shall be considered for evaluation and He/She has to suffer two grade penalty for the third attempt and for 4th and subsequent attempts shall be awarded a grade "P" or "F" or "X" based on his/her performance. However, if a student takes more than three chances (regular examination being the first chance, re-examination being the second chance, to clear a course, then the maximum passing grade that he/she can get shall be only "P". Thus a student has to suffer a grade penalty by accepting a lower grade than that obtained in the regular examination, re-examination, or examination for a re-registered course.

15.0 Calculationof Performance Indices:

15.1. Semester Grade Point Average (SGPA)

The performance of a student in a one specific semester is indicated by SGPA. SGPA is a weighted average of the grade points obtained in all courses registered by the students during the semester. SGPA can be calculated by following equation.

$$SGPA = S_i = \frac{\sum_{i=1}^{n} C_i P_i}{\sum_{i=1}^{n} C_i}$$

Where, i = 1,2,3…….n are number of courses during semesters. C = No of credits associated with that course and P = Grade point earned in that course. SGPA will be rounded off to two decimal places.

15.2. Cumulative Grade Point Average (CGPA)

The total cumulative performance of a student at the end of specific semester is indicated by CGPA. An up-to-date assessment of the overall performance of a student for the courses from the first semester onwards till completion of the program shall be obtained by calculating Cumulative Grade Point Average (CGPA). CGPA is a weighted average of the SGPA obtained in all semesters by the students during the semesters. CGPA can be calculated by following equation.

$$CGPA = \frac{\sum_{j=1}^{n} C_j S_j}{\sum_{j=1}^{n} C_j}$$

Where, j = 1,2,3…….n are number of semester during program. C = Total No of credits in the semester for which CGPA is to be calculated.
CGPA will be rounded off to two decimal places.
Conversion of CGPA to percentage marks for CGPA ≥ 4.5 can be obtained using equations. Percentage marks = (CGPA x 10) – 7.5.

15.3. For the students acquiring "I" grade (which is only a temporary grade) in any of the courses, SGPA, CGPA shall be calculated only after make-up examination.

15.4. **First Year Performance Index (FYPI):(Applicable For B. Tech Programs Only)**

15.4.1. For a student registered in Sanjay Ghodawat University Kolhapur right from the First semester, First-Year-Performance-Index (FYPI) shall be calculated as weighted average of the grade points obtained in all the courses registered by him/her in semesters I and II only.

$$\text{FYPI} = \frac{\sum_{i} C_i g_i}{\sum_{i} C_i}$$

Where summation is for all the courses registered by a student in first two semesters. FYPI shall be calculated when SPI for the second semester is calculated. FYPI shall be rounded off to two decimal places.

15.4.2. FYPI shall reflect all the courses undergone by a student in the first year including the courses in which he/she has failed. FYPI may get modified in the subsequent semesters whenever a student clears his/her first year backlog courses.

15.4.3. If a student has been awarded "I" grade in the regular semester course of the first year then, FYPI shall be calculated after the make-up examination on the basis of the grade obtained by that student in a make-up examination.

15.4.4. If a student has obtained grade "F" or "X" at any time in any of the courses registered by him, then zero grade points corresponding to these grades shall be taken into consideration for calculation of FYPI.

16.0 Maximum Duration for Completing the Program

Maximum duration for completing any program UG/PG offered by Sanjay Ghodawat University is respective program duration plus two additional years.

Maximum duration for getting the B. Tech degree for students admitted in the first semester of UG program is, program duration plus two additional years (i.e. 12 Semesters and 6 academic years) For lateral entry student academic admitted in the third semester shall be (10 Semester and 5 Years).

The maximum duration of the program includes the period of withdrawal, absence and different kind of leaves permission to student but excludes the period of rustication of the student from the university however genuine case an confidential of valid reason may be referred to academic council for extending this limit by additional criteria

17.0 NFTE (Not Fit for Technical Education)(Applicable to B Tech program only)

It is mandatory for the student to earn all credits of first year specified for semester I & II or eligible for ATKT as per the rules to seek admission to semester III of second year in three years from the date of admission to avoid NFTE. If a student fails to become eligible for admission to Semester III in three year form the date of his admission, he shall be declared as "Not Fit for Technical Education" leading to discontinuation of his/her registration with the university. Such cases should be put up in the academic council.

18.0 AcademicProgress Rules (ATKT Rules):

18.1. A student shall be allowed to register for the courses of the next year's odd semester only if he/she has earned all the credits of the previous year and has earned at least 75% credits of the current year. If 75% calculation turns out to be a mixed number (integer + fraction) then only the integer part of that number shall be considered for deciding the eligibility for ATKT.

18.2. At the end of 1st year a student shall be allowed to keep terms (ATKT) to 2nd year of study provided he/she attends course work prescribed for 1st year with prescribed attendance and successfully earned at least 75% of the total credits specified for 1st year program.

For Example: Total credits for B. Tech first year 2017-18, are 45 (Total of Semester I and II). A Student should earn mininum75% of the 45 Credits i.e. 33.15 (Rounded to 33 Credits). A student can go to next higher class with a maximum backlog of 12 credits of semester I & II of the first year.

(a) Student, who fails to earn those credits, cannot register for next semester, either it can re-registrar for the course and credits or can use the next opportunity to earn the credits when exams are conducted. .

(b) At the end of 2nd year a candidate shall be allowed to keep terms to 3rd year of

study provided he/she attends course work prescribed for 2nd year with prescribed attendance, and successfully cleared 1st year program and at least 75% of total credits prescribed for 2nd year program.

(c) At the end of 3rd year a candidate shall be allowed to keep terms to final year of study provided he/she attendants course work prescribed for 3rd year with prescribed attendance, and should have completed 2nd year program and 75% of total credits prescribed for 3rd year program.

All such candidates fulfilling the above criteria shall be declared as FAILED, ATKT.

A student shall be allowed to take admission for odd semester of next academic year only if he/ she have earned all the credits of the previous year and 75% happens to be a decimal, it is rounded to only integer part.

19.0 SemesterGrade Report:

19.1. Semester grade report reflects the performance of a student in that semester (SGPI) and also his/her cumulative performance for the first year (FYPI) and also the cumulative performance since the third semester of his/her study (CGPA).

19.2. The semester grade card issued at the end of each semester/ summer term to each student shall contain the following.

- The credits for each course registered for that semester.
- Any audit course/s undertaken by a student in a Semester.
- The letter grade obtained in each course.
- The total number of credits earned by a student for the first year separately.
- The total number of credits earned by a student since the 3rd semester onwards.
- SGPI, FYPI, CGPI.
- A list of backlog courses, if any.
- Remarks regarding eligibility of registration for the next semester.

19.3. Semester grade card shall not indicate class or division or rank however a conversion from grade point index to percentage based on CGPI shall be indicated on the final grade card of the program.

20.0 Award of Degree:

Following rules prevail for the award of degree.

- A student has registered and passed all the prescribed courses under the general institutional and departmental requirements.
- A student has obtained CGPI ≥ 4.75.
- A student has paid all the institute dues and satisfied all the requirements prescribed.

- A student has no case of indiscipline pending against him/her.
- Academic Council shall recommend the award of degree to a student who is declared to be eligible and qualified for above norms.

21.0 Grace Marks

- Maximum total grace marks will be 1 % of the total theory credit courses x 100 subjected
- To maximum 6 marks in that semester.
- Grace marks will be given candidate for change in grades for theory credit courses, i.e. from
- Fail to pass grade only and will be reflected in final ESE marks.
- The grace marks are applicable only for maximum 1/3rd courses (rounded to higher
- Integer part i.e. if there are 4 theory courses then 4/3 = 1.33 = 2 courses).
- Maximum grace marks will be distributed in maximum courses
- Benefit of grace marks is not applicable for any medal/award.
- Applicable to theory and (Theory + Practical Courses). If is not applicable for Practical courses.
- Scheme for grace marks only can be used when the student will pass in all courses of that semester.

22.0 CGPA Improvement Policy for Award of Degree:

An opportunity shall be given to a student who has earned all the credits required by the respective program with CGPA greater than or equal to 4.00 but less than 4.75 to improve his/her grade by allowing him/her to appear for ESE examinations of maximum two theory courses of seventh semester. Such examinations shall be scheduled along with re-examinations/make-up examinations. However, CGPA shall be limited to 4.75 even though the performance of a student as calculated through modified CGPA becomes greater than 4.75.

Conclusions:

The academic policies regarding conduct of programs in Sanjay Ghodawat University Kolhapur are published in this document. The Academic Council shall reserve the right to modify these policies as and when required from the point of view of achievingAcademic excellence. In special and abnormal cases (i.e. the cases not covered through above rules) the decision of the (Chairman, Academic Council shall be final and shall be binding on all concerned.

Chairman (Academic Council)

Structure for M. Tech Artificial Intelligence and Data Science Program (AY 2021-22) R0 Semester I									
Course Code	**Course Title**	**L**	**T**	**Pr**	**C**	**Component**	**Evaluation Scheme**		
							Exam	**WT%**	**Min. Pass**
AID501 (PC | ST) Version:1.0	Linear Algebra and Calculus	3	-	-	3	Theory 100 Marks	FET	20	40%
							CAT I	15	
							CAT II	15	
							ESE	50	40%
AID503 (PC | ST) Version:1.0	Computational Intelligence	3	-	-	3	Theory 100 Marks	FET	20	40%
							CAT I	15	
							CAT II	15	
							ESE	50	40%
AID505_ (PE | ST) Version:1.0	Program Elective I	3	-	-	3	Theory 100 Marks	FET	20	40%
							CAT I	15	
							CAT II	15	
							ESE	50	40%
AID507_ (PE | ST) Version:1.0	Program Elective II	3	-	-	3	Theory 100 Marks	FET	20	40%
							CAT I	15	
							CAT II	15	
							ESE	50	40%
UC501R2 (UC|ST) Version:2.0	Research Methodology	2	-	-	2	Theory 100 Marks	FET	20	40%
							CAT I	15	
							CAT II	15	
							ESE	50	40%
AID511 (PC | ST) Version:1.0	Laboratory I	-	-	4	2	Practical 100 Marks	FEP	50	40%
							POE	50	40%
AID513 (PC | ST) Version:1.0	Laboratory II	-	-	4	2	Practical 100 Marks	FEP	50	40%
							POE	50	40%
UC5-- (UC|ST) Version:2.0	Audit Course- 1	2	-	-	-	Audit	FEP	100	-
Total		**16**	**-**	**08**	**18**	**Total Hours: 24, Total Credits: 18**			

FET – Faculty Evaluation Theory; **CAT –** Continuous Assessment Test; **ESE –** End Semester Examination; **FEP –** Faculty Evaluation Practical

Structure for M. Tech Artificial Intelligence and Data Science Program (AY 2021-22) R0 Semester II									
Course Code	**Course Title**	**L**	**T**	**Pr**	**C**	**Component**	**Evaluation Scheme**		
							Exam	**WT%**	**Min. Pass**
AID502 (PC | ST) Version:1.0	Statistical Learning & Probability	3	-	-	3	Theory 100 Marks	FET	20	40%
							CAT I	15	
							CAT II	15	
							ESE	50	40%
AID504 (PC | ST) Version:1.0	Optimization Methods for Analytics	3	-	-	3	Theory 100 Marks	FET	20	40%
							CAT I	15	
							CAT II	15	
							ESE	50	40%
AID506_ (PE | ST) Version:1.0	Program Elective III	3	-	-	3	Theory 100 Marks	FET	20	40%
							CAT I	15	
							CAT II	15	
							ESE	50	40%
AID508_ (PE | ST) Version:1.0	Program Elective IV	3	-	-	3	Theory 100 Marks	FET	20	40%
							CAT I	15	
							CAT II	15	
							ESE	50	40%
AID510 (PC | ST) Version:1.0	Employability Skills – (Project based learning): Level I		-	4	2	Practical 100 Marks	FEP	50	40%
							POE	50	40%
AID512 (PC | ST) Version:1.0	Laboratory III	-	-	4	2	Practical 100 Marks	FEP	50	40%
							POE	50	40%
AID514 (PC | ST) Version:1.0	Laboratory IV	-	-	4	2	Practical 100 Marks	FEP	50	40%
							POE	50	40%
UC5-- (UC|ST) Version:2.0	Audit Course - 2	2	-	-	-	Audit	FEP	100	-
Total		**14**	**-**	**12**	**18**	**Total Hours: 26, Total Credits: 18**			

FET – Faculty Evaluation Theory; **CAT –** Continuous Assessment Test; **ESE –** End Semester Examination; **FEP –** Faculty Evaluation Practical

Structure for M. Tech Artificial Intelligence and Data Science Program (AY 2021-22) R0 Semester III									
Course Code	**Course Title**	**L**	**T**	**P**	**C**	**Evaluation Scheme**			
						Component	**Exam**	**WT (%)**	**Min. Pass %**
AID601 (PW|ST) Version:1.0	Mini Project – (Project based learning) : Level II		-	8	4	Practical 100 Marks	FEP	50	40
							POE	50	40
AID603 (OE|ST) Version:1.0	Open Elective (Self learning)	4	-	-	4	Theory 100 Marks	FET	100	40%
AID605 (PW|ST) Version:1.0	Dissertation Phase I	-	-	12	6	Presentation	FEP	100	40
AID607 (PW|ST) Version:1.0	Dissertation Phase II	-	-	12	6	Presentation, Report	FEP	50	40
							ESE	50	40
		4	**-**	**32**	**20**	Total Hours: **32**, Total Credits: **20**			

Structure for M. Tech Artificial Intelligence and Data Science Program (AY 2021-22) R0 Semester IV									
Course Code	**Course Title**	**L**	**T**	**P**	**C**	**Evaluation Scheme**			
						Component	**Exam**	**WT (%)**	**Min. Pass %**
AID602 (PW|ST) Version:1.0	Dissertation Phase III	-	-	16	8	Presentation	FEP	100	40
AID604 (PW|ST) Version:1.0	Dissertation Phase IV	-	-	16	8	Viva Voce Exam	ESE	100	40
		-	**-**	**32**	**16**	Total Hours: **32**, Total Credits: **16**			

FET – Faculty Evaluation Theory; **CAT –** Continuous Assessment Test; **ESE –** End Semester Examination; **FEP –** Faculty Evaluation Practical

Total Credits: 18+18+20+16 = **72**

Course Code	Course Title
Program Elective I	
AID5051	Advanced Data Structures
AID5052	Deep Learning
Program Elective II	
AID5071	Bioinformatics
AID5072	Pattern Recognition
Program Elective III	
AID5071	Natural Language Processing
AID5072	Computer Vision
Program Elective IV	
AID5071	Reinforcement Learning
AID5072	Information Retrieval

Audit Course- 1&2

UC5021R2 English for Research Paper Writing
UC5022R2 Disaster Management
UC5023R2 Sanskrit for Technical Knowledge
UC5024R2 Value Addition
UC5025R2 Constitution of India
UC5026R2 Pedagogy Studies
UC5027R2 Stress Management by Yoga
UC5028R2 Personality Development through Life Enlightenment Skills

AID501 : Linear Algebra and Calculus							
Ver 1.0, Program Core, School of Technology							
Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	Weightage	Pass
3	-	-	3	Theory 100 Marks	FET	20	40%
					CAT I	15	
					CAT II	15	
					ESE	50	40%

Prerequisite: Fundamental knowledge of linear algebra and calculus is required.

Course Description: Linear algebra and Basic Analysis is the study of linear systems of equations, vector spaces, and linear transformations. Solving systems of linear equations is a basic tool of many mathematical procedures used for solving problems in science and engineering.

Course Objectives:

i. Use computational techniques and algebraic skills essential for the study of linear systems equations, matrix algebra, vector spaces,
ii. Compute Eigen values and Eigen vectors find orthogonality and diagonalization

Course Outcomes: After the end of this course students will be able to

CO1 **Apply**[3] mathematical methods involving arithmetic, algebra, geometry, and graphs to solve problems

CO2 **Represent**[3] mathematical information and communicate mathematical reasoning symbolically and verbally

CO3 **Analyze**[4] numerical data, mathematical concepts, and identify patterns to formulate and validate reasoning

CO4 **Construct**[3] mathematical arguments that relate to the study of introductory linear algebra.

Syllabus (Theory)

Units	Description	Hours
I.	Revision of basic Calculus (Integration, differentiation). Introduction to Multivariate Calculus. Introduction to Taylor Series, Solution of linear equations, Vector space	**7**
II.	Linear transformation, matrix representation, inner-products and norms Orthogonality	**7**
III.	Gram-Schmidt algorithm , Matrices and Basic Operations, interpretation of matrices as linear mappings	**7**

IV.	Properties of determinants, singular and non-singular matrices, examples, Matrix Inverse, finding an inverse matrix, Characteristic Polynomial	**7**
V.	Eigenvalues and eigenvectors, Definition of Left/right Eigenvalues and Eigenvectors	**7**
VI.	Caley-Hamilton theorem, interpretation of eigenvalues/vectors, Singular Value Decomposition	**7**

Textbooks:

1. G.Strang, *Linear Algebra and its Applications*, Wellesley-Cambridge Press, 2016.

References :

1. S. Axler, *Linear Algebra Done Right*, Springer, 2015.

AID503: Computational Intelligence							
Ver 1.0, Program Elective, School of Technology							
Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	Weightage	Pass %
3	-	-	3	Theory (100)	FET	20	40%
					CAT I	15	
					CAT II	15	
					ESE	50	40%

Prerequisite: Foundation in calculus, linear algebra, and statistics

Course Description: Computational intelligence is a research field that studies to realize the intelligent human behaviors on a computer. The ultimate goal is to make a computer that can learn, plan, and solve problems autonomously. The research areas include problem solving, reasoning, planning, natural language understanding, computer vision, automatic programming, machine learning, and so on.

Course Objectives:

i. Provide the most fundamental knowledge to the students so that they can understand what the computational intelligence is.
ii. Explore use cases and applications of computational intelligence

Course Outcomes: After the end of this course students will be able to

CO1 **Demonstrate**[3] knowledge of the fundamental principles of artificial intelligent systems

CO2 **Analyse**[4] and compare the relative merits of a variety of AI problem solving techniques.

CO3 **Select**[4] the models, methods, and algorithms of artificial intelligence

Syllabus (Theory)

Units	Description	Hours
I.	**Introduction: AI problem;** AI techniques, problem as a state space search, Production Systems, Issues in design of search programs. Physical Symbol Systems and the scope of Symbolic AI, Agents. State Space Search: Depth First Search, Breadth First Search.	7
II.	**Heuristic Search Techniques:** Generate-And- Test, Hill Climbing, Best-First Search. Problem Reduction, Simulated Annealing, Constraint Satisfaction, Means-Ends Analysis. Population Based Search: Genetic Algorithms, Ant Colony Optimization.	7
III.	**Knowledge Representation:** Procedural Vs Declarative Knowledge, Representations & Approaches to Knowledge Representation, Forward Vs Backward Reasoning, Matching Techniques, Partial Matching, RETE Matching Algorithms.	7

IV.	**Logic Based Programming, AI Programming languages:** Overview of LISP, Search Strategies in LISP, Pattern matching in LISP , An Expert system Shell in LISP, Over view of Prolog, Production System using Prolog	**7**
V.	**Problem Decomposition, Algorithm AO, Game Playing, Game Playing:** Algorithms Minimax, AlphaBeta, SSS.	**7**
VI.	**Experts Systems:** Overview of an Expert System, Structure of an Expert Systems, Different Types of Expert Systems- Rule Based, Model Based, Case Based and Hybrid Expert Systems. Knowledge Building System Tools, Expert System Shells, Fuzzy Expert systems.	**7**

Textbooks:

1. George F Luger, *Artificial Intelligence*, Pearson Education Publications, 2001.
2. Elaine Rich and Knight, *Artificial Intelligence*, Mcgraw-Hill Publications, 2017.

References :

1. David Rolston, *Principles of AI and Expert system development*, MGH, 1988.

AID5051 : Advanced Data Structures							
Ver 1.0, Program Elective, School of Technology							
Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	Weightage	Pass
3	-	-	3	Theory 100 Marks	FET	20	40%
					CAT I	15	
					CAT II	15	
					ESE	50	40%

Prerequisite: Design and analysis of algorithms

Course Description: Data structures play a central role in modern computer science. You interact with data structures even more often than with algorithms (think Google, your mail server, and even your network routers). In addition, data structures are essential building blocks in obtaining efficient algorithms.

Course Objectives:

i. To provide the foundations of the practical implementation and usage of Algorithms and Data Structures.
ii. To expose the student to the algorithm analysis techniques using advanced data structures.

Course Outcomes: After the end of this course students will be able to

CO1 **Choose**[4] appropriate data structures for a specific problem
CO2 **Use**[3] the ADT/libraries to design algorithms for a specific problem.
CO3 **Select**[3] algorithm design approaches in a problem specific manner.
CO4 **Understand**[3] the necessary mathematical abstraction to solve problems.

Syllabus (Theory)

Units	Description	Hours
I.	Priority queues and heaps, dictionaries, bloom filters, binary search trees, interval trees, AVL trees, red-black trees, Splay Trees, Tango Trees.	7
II.	Temporal Data Structures: Persistent data structures - Model and definitions, Partial persistence, Full persistence, Retroactive data structures	7
III.	Vertex colouring, edge colouring, Network flows: Max flow – mincut theorem, Probabilistic methods – Markov's inequality.	7
IV.	Hash Function, Basic Chaining, FKS Perfect Hashing, Linear Probing. union-find, range trees, fractional cascading	7
V.	Predecessor Problem, Suffix Trees, Suffix Arrays, DC3 Algorithm for Building Suffix Arrays, Tries.	7

VI.	Dynamic trees - Link-cut Trees, Operations on link-cut trees, Dynamic Connectivity, Euler-Tour Trees, Other Dynamic Graph Problems, Augmenting Data Structures.	**7**

Textbooks:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, *Introduction to Algorithms*, 3rd Edition, PHI, 2009
2. Harsh Bhasin, *Algorithms Design and Analysis*, Oxford University Press 2015

References :

1. Anany Levitin, *Introduction to the Design and Analysis of Algorithms*, Pearson Education, 2015
2. M. A. Weiss, *Data Structures and Algorithm Analysis in Java*, Pearson Education Asia, 2013

AID5052: Deep Learning							
Ver 1.0, Program Elective, School of Technology							
Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	Weightage	Pass
3	-	-	3	Theory 100 Marks	FET	20	40%
					CAT I	15	
					CAT II	15	
					ESE	50	40%

Prerequisite: Knowledge in Linear Algebra and Probability, Machine learning

Course Description: This course is an introduction to deep learning, a branch of machine learning concerned with the development and application of modern neural networks. Deep learning algorithms extract layered high-level representations of data in a way that maximizes performance on a given task.

Course Objectives:

i. To provide exposure to deep learning topics
ii. To discuss deep learning methods for working with sequential data
iii. To illustrate how to apply such deep learning mechanisms to various learning problems

Course Outcomes: After the end of this course students will be able to

CO1 **Understand**[2] the algorithmic topics of deep learning
CO2 **Build**[6] application using Convolutional Neural Networks & Sequence modeling
CO3 **Apply**[3] the Auto Encoders in practical applications
CO4 **Use**[6] deep learning architectures for developing applications

Syllabus (Theory)

Units	Description	Hours
I.	**Introduction To Deep Learning:** History of Deep Learning ,Introduction to deep learning-Solving methodology, Deep learning software SVD applied on handwritten digits using scikit-learn, SVD applied on handwritten digits using scikit-learn, Deep Learning Success Stories, Logic, Perceptron Learning Algorithm and Convergence, Multilayer Perceptron(MLPs), Representation Power of MLPs	7
II.	**Fundamentals Concepts of Machine Learning:** Historical Trends in Deep Learning-Machine Learning Basics: Learning Algorithms-Supervised and Unsupervised Training, Testing, Cross-Validation, Over/Under-fitting, Hyper parameters and validation sets, Estimators, Bias, Variance, Regularization-Introduction to a simple DNN, Platform for deep learning,	7

Deep learning software libraries.

III.	**Deep Feed Forward Networks:** Deep feed forward networks- Introduction- Learning XOR- Gradient-Based Learning- Various Activation Functions, error functions- Architecture Design-differentiation algorithms- Regularization for Deep learning-Early Stopping, Drop out.	**7**
IV.	**Convolutional Neural Networks and Recurrent Neural Networks :** Convolutional layers, Object Detection, Kernel, Cross-correlation and convolution operation, Padding, Stride, Pooling, Image augmentation, SGD for CNNs, 3D CNNs, Sequence Modeling, RNN Models, LSTM	**7**
V.	**Auto Encoders:** Auto encoders - Auto encoders: under complete, regularized, stochastic, denoising, contractive, applications – dimensionality reduction, classification, recommendation, Optimization for Deep Learning: optimizers. RMS Prop for RNNs	**7**
VI.	**Deep Architectures In Vision:** Deep Architectures in Vision - Alexnet to ResNet, Transfer learning, Siamese Networks, Metric Learning, Ranking/Triplet loss, RCNNs, CNN-RNN, Applications in captioning and video tasks , Generative adversarial networks	**7**

Textbooks:

1. Ian Goodfellow, YoshuaBengio, Aaron Courville, *Deep Learning*, MIT Press, 2016 (available at http://www.deeplearningbook.org)
2. Kevin P. Murphy, *Machine Learning: A Probabilistic Perspective*, MIT Press, 2012

References :

1. Michael Nielsen, *Neural Networks and Deep Learning*, Online book, 2016 (http://neuralnetworksanddeeplearning.com/)
2. Jason Brownlee , *Deep Learning with Python*, Ebook, 2016

AID5071 : Bioinformatics							
Ver 1.0, Program Elective, School of Technology							
Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	Weightage	Pass
3	-	-	3	Theory 100 Marks	FET	20	40%
					CAT I	15	
					CAT II	15	
					ESE	50	40%

Prerequisite: Basic Biology

Course Description: The course aims to give overview of concepts and databases from bioinformatics and use of artificial intelligence in biology and medical field.

Course Objectives:

i. To discuss techniques to search and retrieve information from genomic and proteomic databases.
ii. To illustrate how to compare and analyze biological sequences and how to interpret the results of their analyses
iii. To familiarize students with applications of AI techniques for biological and medical problems

Course Outcomes: After the end of this course students will be able to

CO1 **Identify**[2] biological data, submission and retrieval it from databases and design databases to store the information.
CO2 **Analyze**[3] the most important bioinformatics databases, perform text- and sequence based searches, and analyze the results in light of molecular biological knowledge.
CO3 **Apply**[3] machine learning techniques in bioinformatics
CO4 **Develop**[4] case studies for applying medical image processing and supervised machine learning techniques in bioinformatics

Syllabus (Theory)

Units	Description	Hours
I.	**Basics of Bioinformatics**: Introduction to Bioinformatics; Computers in Biology to understand Biological System; Open resources in Bioinformatics.	7
II.	**Sequence Analysis**: Biological background for sequence analysis; Sequence alignment: Global, Local, Pairwise and Multiple sequence analysis; Algorithm for alignments; Database Searching; Tools for Sequence alignment.	7

III.	**Biological Databases**: Database concepts; Introduction to Data types and source; Protein Sequence and Structural Databases; Nucleic acid databases; Genome databases; Specialized Databases; Carbohydrate Databases; Clinically relevant drug-drug interactions databases; Information retrieval from Biological databases: Entrez system, TCGA data bases, Bioportal	**7**
IV.	**Feature Interpretation for Biological Learning**: Introduction, Normalization Techniques for Gene Expression Analysis, Data preprocessing of Mass Spectrometry Data, Techniques for MS Data Analysis, Data Preprocessing for Genomic Sequence Data, Ontologies in Bioinformatics	**7**
V.	**Medical Image Processing**: Feature extraction, identifying positions of features - Normalization – data cleaning and transformation, deep learning for medical image processing	**7**
VI.	Recent case studies and applications of supervised learning techniques in Bioinformatics	**7**

Textbooks:

1. Lesk, A.M., *Introduction to Bioinformatics*; Oxford University Press, UK, Fourth edition, 2014
2. Gretchen Kenney, *Bioinformatics: Principles and Analysis*; Syra wood Publishing House USA, 2016

References :

1. Hooman Rashidi, Lukas K., *Bioinformatics Basics: Applications in Biological Science and Medicine*, Buehler Publisher: CRC Press/Taylor & Francis Group, 2005. (ISBN: 978-08-493-2375-1)
2. Ian Goodfellow, Deep Learning (Adaptive Computation And Machine Learning Series) , The MIT Press , 2016

AID5072: Pattern Recognition							
Ver 1.0, Program Elective, School of Technology							
Lect.	**Tut.**	**Pract.**	**Credits**	**Evaluation Scheme**			
				Component	**Exam**	**Weightage**	**Pass %**
3	-	-	3	Theory 100 Marks	FET	20	40%
					CAT I	15	
					CAT II	15	
					ESE	50	40%

Prerequisite: Strong background in Linear Algebra , Probability and Statistics.

Course Description: This course focuses on the underlying principles of pattern recognition and on the methods of machine intelligence used to develop and deploy pattern recognition applications in the real world. Emphasis is placed on the pattern recognition application development process, which includes problem identification, concept development, algorithm selection, system integration, test and validation the design, analysis, and development of methods for the classification or description of patterns, objects.

Course Objectives:

i. Learn the fundamentals of pattern recognition and its relevance to classical and modern problems.
ii. Identify where, when and how pattern recognition can be applied.
iii. Introduction to more recent applications of pattern recognition, such as cognitive neuroscience and bioinformatics.

Course Outcomes: After the end of this course students will be able to

CO1 **Justify**[5] the general working of the Machine Learning algorithms.

CO2 **Create**[6] complex model by piecing the basic blocks learnt.

CO3 **Examine**[4] the interpreted data and results.

CO4 **Evaluate**[5] quality of solution of the pattern recognition system.

Syllabus (Theory)

Units	Description	Hours
I.	Introduction to Statistical Pattern Recognition Overview of Pattern Classifiers Bayes Classifier and Nearest Neighbor Classifier Minmax and Neymann-Pearson Classifiers.	**7**
II.	Maximum Likelihood Estimation of various class conditional densities Bayesian estimation and MAP estimates Exponential family of densities Sufficient Statistics and recursive formulation of ML and Bayesian estimates.	**7**
III.	Introduction to Mixture Densities EM Algorithm Non-parametric density estimation using Parzen Window and nearest neighbour methods.	**7**

IV.	Introduction to Linear Models Linear Discriminant Functions Linear Regression vs Multi-variate Regression Perceptron Learning, Algorithm and convergence proof LMS Algorithm Logistic Regression Fisher Linear Discriminant Multi-class logistic regression.	**7**
V.	PAC learning framework Empirical Risk Minimization Concept of Generalization Bias-Variance Trade-off Thorough understanding of VC-dimension with examples.	**7**
VI.	Artificial Neural Network and related terms Activation functions Feedforward Neural Network with Backpropagation algorithm Regularization and momentum in Artificial Neural Network, Artificial Neural Network used for classification and regression task, Radial Basis Functions, Gaussian RBF networks.	**7**

Textbooks:

1. 'Pattern Classification', R. O. Duda, P.E. Hart and D.G. Stork, Johy Wiley, Publication
2. 'Pattern Recognition and Machine Learning', C.M. Bishop, Springer Publication

References:

1. Deep Learning, I. Goodfellow, Y. Bengio and A. Courville C. M. Bishop, MIT Press Publication.
2. Learning From Data, Yaser S. Abu-Mostafa, Malik Magdon-Ismail, Hsuan-Tien Lin, AML Book

AID509: Research Methodology

(Ver 1.0, University Core, School of Technology)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT%	Min. Pass
2	-	-	2	Theory	FET	20	40%
					CAT I	15	
					CAT II	15	
					ESE	50	40%

Syllabus (Theory)

Units	Description	Hrs
I	**Research:** Definition of research, Applications of research and types, Research process and steps in it, Deductive and inductive reasoning; Validity-conclusion, internal, construct and external; Problem Solving – Types, Process and Approaches – Logical, Soft System and Creative; Creative problem solving process, Development of Creativity, Group Problem Solving Techniques for Idea Generation – Brain storming and Delphi Method.	06
II	**Single Factor Experiment:** Analysis of Variance (ANOVA) for fixed effect model; Total treatment and error sums of squares, Decomposition of total sum of squares, ANOVA for Randomized complete block design to control effects of nuisance factors. **Two factor Factorial Design**: Basic definitions and principles, main effect and interaction, response surface and contour plots, Blocking, General arrangement for a two factor factorial design; Models- Effects, means and regression.	06
III	**Taguchi Techniques for Experimental Design:** Taguchi loss function, Average loss, nominal-the-best, smaller-the-best, larger-the-best, design process steps, selection of factors affecting- methods, factor levels, Test strategies- Full factorial experiment, fractional factorial experiment, Orthogonal arrays and their selection; Interaction effects, Parameter Design- Control and noise factors and parameter design, signal to noise ratio, types, parameter design strategy, tolerance design, robust design.	06
IV	**Design of Experiments (DOE):** Objectives, strategies, Factorial experimental design, Designing engineering experiments, basic principles- replication, randomization, blocking, Guidelines for design of experiments, process of DOE, Simple Comparative Experiments- Basic statistical concepts, random variable, sample mean and variance, degrees of freedom, standard normal distribution, statistical hypothesis, Two sample t test-value, Confidence intervals, Paired comparison.	06
V	**Literature review:** Need, Procedure- Search for existing literature, Review the literature selected, Develop a theoretical and conceptual framework, Writing up the review, Formulating a research problem: Sources, Considerations, Steps in formulation of a problem, formulation of objectives, Definition of variables – Concepts, indicators and variables, Types of variables, Types of measurement scales, Constructing the Hypothesis- Null(Research) and alternative, one-tailed	06

and two-tailed hypotheses, Hypothesis testing, errors in testing.

VI	**Research Modeling:** Types of Models, Model building and stages, Data consideration and testing, Heuristic and Simulation modeling, Data collection methods, Surveys-types and method selection. **Research Proposal**: Contents-Preamble, the problem, objectives, hypothesis to be tested, study design, setup, measurement procedures, analysis of data, organization of report; Displaying data- tables, graphs and charts, Writing a research report-Developing an outline, Key elements- Introduction, Methods, Measurement section, Design& procedure section, Results, conclusion section, Referencing of books and research papers, Report Writing- Prewriting considerations, Thesis writing, Formats of report writing, Formats of publications in Research journals.	06

References

1. Krishnaswamy, K. N., Sivakumar, AppaIyer and Mathirajan, M. (2006), Management Research Methodology: Integration of Principles, Methods and Techniques (Pearson Education, New Delhi)
2. Montgomery, Douglas C. (2007) – Design & Analysis of Experiments, 5/e. (New Delhi,Wiley Student Edition, Wiley India Pvt. Ltd.) ISBN: 978-81-265-1048-1
3. Montgomery, Douglas C. &Runger, George C. (2007) – Applied Statistics & Probability for Engineers, 3/e, . (New Delhi, Wiley Student Edition, Wiley India Pvt. Ltd.), ISBN:978-81-265-1424-3
4. Ranjit Kumar, (2006), Research Methodology- A Step-By-Step Guide for Beginners,(Pearson Education, Delhi) ISBN: 81-317-0496-3
5. Trochim, William M.K., (2003), 2/e, Research Methods, (Biztantra, DreamtechPress,New Delhi), ISBN: 81-7722-372-0
6. Kothari, C.K., (2004), 2/e, Research Methodology- Methods and Techniques, (NewAge International, New Delhi)
7. Ross, Philip J. (1996), 2/e, Taguchi Techniques for Quality Engineering, (McGraw Hill,New York)
8. Dean, Angela & Voss, Daniel, - Design & Analysis of Experiments, (1999), (Springer Verlag), ISBN: 0-387-98561-1
9. Panneerselvam – Research Methodology, (PHI), ISBN: 81-203-2452-8.
10. Ramana, B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, (2008).

AID511 : Laboratory I							
Ver 1.0, Program Core, School of Technology							
Lect.	**Tut.**	**Pract.**	**Credits**	**Evaluation Scheme**			
				Component	**Exam**	**Weightage**	**Pass %**
-	-	4	2	Practical 100 Marks	FEP	50	40%
					POE	50	40%

Prerequisite: Python Programming, Introduction of Machine Learning

Course Description:
This course contains machine learning theory combined with practical scenarios and hands-on experience building, validating and deploying machine learning models.

Course Objectives:

i. To introduce data exploration, preparation and cleaning
ii. To impart knowledge of supervised machine learning techniques
iii. To discuss unsupervised machine learning techniques and model performance improvement

Course Outcomes: After the end of this course students will be able to

CO1 **Design**[5] Map reduces application for real world problem
CO2 **Implement** [5] machine learning algorithms in R
CO3 **Develop** [5] algorithms for social media analytics in R

Practical

Two hours per week per batch practical is to be utilized for writing programs to ensure that students have properly learnt the topics covered in the lectures. It should comprise of minimum 10-12 experiments. Students of different batches should implement different programs based on the following guidelines-

1. Installation of Hadoop & R
2. Building Hadoop MapReduce Application for counting frequency of words/phrase in simple text file.
3. Study of R: Declaring Variable, Expression, Function and Executing R script.
4. Creating List in R – merging two lists, adding matrices in lists, adding vectors in list.
5. Manipulating & Processing Data in R – merging data sets, sorting data, plotting data, managing data using matrices & data frames .
6. Implementation of Linear Regression Algorithm in R.
7. Implementation of K-Means Clustering with R
8. Implementation Apriori Algorithm for find frequent item set in R.
9. Text Analysis using R: analyzing minimum three different data sets
10. Twitter Data Analysis with R
11. Sentiment Analysis of Whatsapp data by using R

Textbooks:

1. David Dietrich, Barry Hiller, *Data Science & Big Data Analytics*, EMC education services, Wiley publications, 2012.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, *The Elements of Statistical Learning*, Second Edition, Springer Publications, 2011.

References :

1. Carlo Vercellis, *Business Intelligence, Data Mining and Optimization for Decision Making*, Wiley Publications, 2009.
2. Seema Acharya & Subhashini Chellappan, *Big Data & Analytics*, Wiley Publications, 2015.

AID513 : Laboratory II							
Ver 1.0, Program Core, School of Technology							
Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	Weightage	Pass %
-	-	4	2	Practical 100 Marks	FEP	50	40%
					POE	50	40%

Prerequisite: Fundamentals of R Programming Language

Course Description:
In this course we familiarize students with programming and statistical computation in the R environment. Topics that will be covered include amongst others: data handling, fitting statistical models, performing statistical tests, producing graphics, reproducible reports, the basics of programming in R and programming basic statistical algorithms.

Course Objectives:

i. Write efficient transparent programs in R
ii. Produce clear and effective graphical descriptions of data
iii. Analyze data using descriptive and inferential statistics

Course Outcomes: After the end of this course students will be able to

CO1 Import, review, manipulate and summarize data-sets in R

CO2 Explore data-sets to create testable hypotheses and identify appropriate statistical tests

CO3 Write algorithms for social media analytics by using python

Practical

Two hours per week per batch practical is to be utilized for writing programs to ensure that students have properly learnt the topics covered in the lectures. It should comprise of minimum 10-12 experiments. Students of different batches should implement different programs based on the following guidelines-

1. Reading and Getting Data into R
2. Examining Data Structures.
3. Manipulating Objects.
4. Constructing Data Objects.
5. Working with Summary Tables
6. Working with Data Distribution
7. Hypothesis Testing: Student's t-test
8. Hypothesis Testing: The Wilcoxon U-Test (Mann-Whitney)
9. Hypothesis Testing: Correlation and Covariance
10. Creating Data for Complex Analysis
11. Simple Linear Regression
12. Multiple Regression

Textbooks:

1. Gardener, Mark. *Beginning R: The Statistical Programming Language*. Indianapolis: John Wiley & Sons Publications, 2012.

References :

1. Dhaval Mehata, *Statistical Analysis using R Software*, First Edition, Excel Books Private Limited, 2007.

AID502: Statistical Learning and Probability							
Ver 1.0, Program Core, School of Technology							
Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	Weightage	Pass %
3	-	-	3	Theory 100 Marks	FET	20	40%
					CAT I	15	
					CAT II	15	
					ESE	50	40%

Prerequisite: Linear Algebra and Multivariate calculus

Course Description: This course focuses on the problem of supervised and unsupervised learning from the perspective of modern statistical learning theory, starting with the theory of multivariate function approximation from sparse data. It develops basic tools such as regularization, including support vector machines for regression and classification.

Course Objectives:

i. It will provide an overview of the theories and current practices, required by students who intend to specialize in this field
ii. Solve the complex problems in Machine learning applications in different fields.
iii. Uncover the common statistical principles underlying this diverse array of techniques.

Course Outcomes: After the end of this course students will be able to

CO1 **Evaluate**[5] learning methods statistically and recommend the optimal one for applications.
CO2 **Create**[6] the modern statistical techniques with statistical software such as R.
CO3 **Make Use of** [3] global and local methods for prediction**.**
CO4 **Compose**[6] the classification, clustering and dimension reduction techniques.

Syllabus (Theory)

Units	Description	Hours
I.	Discrete Distributions, Random Variables, Binomial Distributions, Geometric Distributions, Plug-in estimators, empirical risk minimization, Linear threshold functions, perceptron algorithm, Variance and bias trade-off. Risk bounds, Concentration inequalities, Uniform convergence, Rademacher averages; combinatorial dimensions	**7**
II.	Minimax strategies for log loss, linear loss, and quadratic loss Linear regression, Subset selection, Ridge regression, Lasso, Principal components regression.	**7**
III.	Polynomial regression, Splines, Local smoothers. K means, Spectral clustering, Clustering evaluation, Model-based clustering, EM algorithm, Latent Dirichlet Allocation model.	**7**
IV.	Classification theory and evaluation, Naïve Bayes classifiers, Logistic regression with regularization, Linear discriminant analysis.	**7**

V.	Regression tree, Pruning, Tree ensembles, AdaBoost, AdaBoost as I-projection, Convergence and consistency of AdaBoost.	**7**
VI.	Support Vector Machine Maximal Margin Classifier, Support Vector Classifiers, Support Vector Machines with more than Two Classes, kernel Methods	**7**

Textbooks:

1. Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, *An Introduction to Statistical Learning with Applications in R*, Springer Publication, 2013
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, *The Elements of Statistical Learning: Data Mining, Inference, and Prediction*, Springer Publication, 2014

References:

1. C. M. Bishop, *Pattern Recognition and Machine Learning*, Springer Publication, 2006

1.

AID504 : Optimization Methods for Analytics							
Ver 1.0, Program Core, School of Technology							
Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	Weightage	Pass
3	-	-	3	Theory (100)	FET	20	40%
					CAT I	15	
					CAT II	15	
					ESE	50	40

Prerequisite: Linear Algebra and Numerical Methods

Course Description: Optimization is the search for the best and most effective solution. In this course, optimization techniques will be examined through a Business Analytics lens. The students will be introduced to the theory, algorithms, and applications of optimization. Linear and integer programming will be applied to problems involving data.

Course Objectives:

i. To introduce optimization techniques using both linear and non-linear programming.
ii. To enable the students to frame engineering minima maxima problems in the framework of optimization problems.

Course Outcomes: After the end of this course students will be able to

CO1 **Apply**[3] the methods of optimization in real life situation
CO2 **Formulate**[4] optimization problems
CO3 **Analyze**[4] and appreciate variety of performance measures for various optimization problems

Syllabus (Theory)

Units	Description	Hours
I	Engineering application of Optimization, Formulation of design problems as mathematical programming problems, General Structure of Optimization Algorithms.	7
II	Linear Programming, modeling (selected models and as a modeling tool), simplex method and modeling language (AMPL). network flow problems	7
III	Quadratic Programming, applied models, (least-squares regression, portfolio selection, support vector machines)	7
IV	Nonlinear Programming, applied models (logistics egression/classification), unconstrained problems,| convex optimization, inequality constraints	7
V	Integer Programming, selected problem classes (knapsack, set covering/partition/packing, logical relations), basic branch and bound and cutting planes methods	7

VI	Recent trends: Applications of ant colony optimization, genetics and linear and quadratic programming in real world applications.	**7**

Textbooks:

1. Laurence A. Wolsey (1998). *Integer programming*. Wiley. ISBN 978-0-471-28366-9.

2. John K. Karlof (2006). *Integer programming: theory and practice*.CRC Press. ISBN 978-0-8493- 1914-3.

References :

1. Dimitris Bertsimas; Robert Weismantel, *Optimization over integers. Dynamic Ideas*. ISBN 978-0-9759146-2-5, 2005.
2. Der-San Chen; Robert G. Batson; Yu Dang, *Applied Integer Programming: Modeling and Solutio*, John Wiley and Sons. ISBN 978-0-470-37306-4, 2010.

AID5061: Natural Language Processing							
Ver 1.0, Program Elective, School of Technology							
Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	Weightage	Pass
3	-	-	3	Theory (100)	FET	20	40%
					CAT I	15	
					CAT	15	
					ESE	50	40

Course Outcomes: After the end of this course students will be able to

CO1 **Choose**[4] the models, methods, and algorithms of statistical natural language Processing

CO2 **Distinguish**[5] core computer science concepts of NLP

CO3 **Understand**[2] applications of NLP

CO4 **Design**[6] linguistic phenomena relevant to each NLP task.

Syllabus (Theory)

Units	Description	Hours
I.	**Overview:** Human languages, models, ambiguity, processing paradigms; Phases in natural language processing, applications. Text representation in computers, encoding schemes	7
II.	**Linguistics :** Introduction to corpus, elements in balanced corpus, Resource management with XML, Management of linguistic data with the help of GATE, NLTK. Regular expressions, Finite State Automata, word recognition, lexicon. Morphology, acquisition models, Finite State Transducer. N-grams, smoothing, entropy, HMM, ME, SVM, CRF.	7
III.	**Tagging:** Stochastic POS tagging, HMM, Transformation based tagging , Handling of unknown words, named entities, multi word expressions. A survey on natural language grammars, lexeme, phonemes, phrases and idioms, word order, agreement, tense, aspect and mood and agreement, Context Free Grammar, spoken language syntax	7
IV.	**Parsing :** Unification, probabilistic parsing, TreeBank. Semantics- Meaning representation, semantic analysis, lexical semantics, WordNet Word Sense	7
V.	**Disambiguation and Disclosure:** Selection restriction, machine learning approaches, dictionary based approaches. Reference resolution, constraints on co-reference, algorithm for pronoun resolution, text coherence, discourse structure.	7

VI.	**Chatboat and other NLP applications:** Chatboat: Concept of chatboat, working of chatboats –scripted, artificially intelligent chatboats, challenges Other applications: Spell-checking, Summarization Information Retrieval- Vector space model, term weighting, homonymy, polysemy, synonymy, improving user queries. Machine Translation– Overview.	**7**

Textbooks:

1. Daniel Jurafsky and James H Martin. *Speech and Language Processing*, 2e, Pearson Education, 2009
2. James A., *Natural language Understanding* 2e, Pearson Education, 1994

References :

1. Bharati A., Sangal R., Chaitanya V. *Natural language processing: a Paninian perspective*, PHI, 2000
2. Siddiqui T., Tiwary U. S. *Natural language processing and Information retrieval*, OUP, 2008

AID5062 : Computer Vision							
Ver 1.0, Program Elective, School of Technology							
Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	Weightage	Pass
3	-	-	3	Theory 100 Marks	FET	20	40%
					CAT I	15	
					CAT II	15	
					ESE	50	40%

Prerequisite: Computer graphics, Data structures

Course Description: The course is about an introduction to the analysis of images and video in order to recognize, reconstruct and model objects in the three-dimensional world. Course describes application of machine learning and deep learning techniques for image and video processing.

Course Objectives:

i. To introduce the student to computer vision algorithms, methods and concepts which will enable the student to implement computer vision systems with emphasis on applications and problem solving.
ii. To familiarize the student with state of the art image and video processing techniques such as CNNs.

Course Outcomes: After the end of this course students will be able to

CO1 **Apply**[4] low level processing on digital images
CO2 **Discuss**[6] multi-camera views
CO3 **Compare**[4] feature extraction & image segmentation methods
CO4 **Analyze**[4] pattern & motion recognition methods

Syllabus (Theory)

Units	Description	Hours
I.	**Digital Image Formation and low-level processing:** Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing	7
II.	**Depth estimation and Multi-camera views:** Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration.	7

III.	**Feature Extraction:** Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT	**7**
IV.	**Image Segmentation:** Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection	**7**
V.	**Pattern Analysis:** Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, Convolution Neural Networks	**7**
VI.	**Motion Analysis:** Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation	**7**

Textbooks:

1. Richard Szeliski, *Computer Vision: Algorithms and Applications*, Springer-Verlag London Limited 2011.
2. D. A. Forsyth, J. Ponce, *Computer Vision: A Modern Approach*, Pearson Education, 2003

References :

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.

2. K. Fukunaga, Second Edition, Introduction to Statistical Pattern Recognition, Academic Press, Morgan Kaufmann, 1990.

3. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.

AID5081 : Reinforcement Learning							
Ver 1.0, Program Elective, School of Technology							
Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	Weightage	Pass %
3	-	-	3	Theory 100 Marks	FET	20	40%
					CAT I	15	
					CAT II	15	
					ESE	50	40%

Prerequisite: Proficiency in Python. Class assignments will be in Python (using Numpy and Tensorflow and optionally Keras), College Calculus, Linear Algebra, Basic Probability and Statistics, Foundations of Machine Learning.

Course Description: This course provides an introduction to some of the foundational ideas on which modern reinforcement learning is built, including Markov decision processes, value functions, Monte Carlo estimation, dynamic programming, temporal difference learning, eligibility traces, and function approximation.

Course Objectives:

i. To learn trading off between exploration and exploitation,
ii. To establish the foundations of the field via Markov decision theory, learning from delayed reinforcement
iii. To construct empirical models to accelerate learning, making use of generalization and hierarchy

Course Outcomes: After the end of this course students will be able to

CO1 **Solve**[3] the problems of dynamic programming
CO2 **Identify**[4] Finite and infinite horizon models
CO3 **Analyze**[4] full state representations and function approximation techniques
CO4 **Apply**[3] Q-learning, temporal difference learning and actor-critic algorithms

Syllabus (Theory)

Units	Description	Hours
I.	Introduction to reinforcement learning & stochastic dynamic programming The dynamic programming algorithm	**7**
II.	Finite and infinite horizon models	**7**
III.	Infinite horizon discounted cost and average cost problems	**7**
IV.	Full state representations & function approximation techniques	**7**
V.	Approximate dynamic programming & partially observable Markov decision processes	**7**

VI.	Q-learning, temporal difference learning, actor-critic algorithms	**7**

Textbooks:

1. Neuro-dynamic programming by Dimitri Bertsekas
2. Reinforcement Learning: An Introduction by Andrew Barto and Richard S. Sutton

References :

1. Reinforcement Learning video lectures by David Silver

AID5082 : Information retrieval							
Ver 1.0, Program Elective, School of Technology							
Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	Weightage	Pass %
3	-	-	3	Theory 100 Marks	FET	20	40%
					CAT I	15	
					CAT II	15	
					ESE	50	40%

Prerequisite: Concept of Data Base Management Systems , algorithms used for searching data

Course Description: This course provides an introduction to some of the foundational ideas on which modern reinforcement learning is built, including Markov decision processes, value functions, Monte Carlo estimation, dynamic programming, temporal difference learning, eligibility traces, and function approximation.

Course Objectives:

i. Demonstrate genesis and diversity of information retrieval situations for text and hyper media.
ii. Describe hands-on experience store, and retrieve information from www using semantic approaches.
iii. Demonstrate the usage of different data/file structures in building computational search engines

Course Outcomes: After the end of this course students will be able to

CO1 **Use**[3] N-grams are used for detection and correction of spelling errors
CO2 **Apply**[3] relevance feedback in vector space model and probabilistic model
CO3 **Apply**[3] the measures to evaluate the performance of cross language information
CO4 **Design**[4] the method to build inverted index.

Syllabus (Theory)

Units	Description	Hours
I.	Introduction: Retrieval strategies: vector space model, Probabilistic retrieval strategies: Simple term weights, Non binary independence model, Language models	7
II.	Retrieval Utilities: Relevance feedback, clustering, N-grams, Regression analysis, Thesauri	7
III.	Retrieval utilities: Semantic networks, parsing Cross –Language: Information Retrieval: Introduction, Crossing the Language barrier	7
IV.	Efficiency: Inverted Index, Query processing, Signature files, Duplicate document detection	7
V.	Integrating structured data and text. A historical progression, Information retrieval as relational application, Semi Structured search using a relational schema.	7

VI.	Distributed Information Retrieval: A theoretical Model of Distributed retrieval, web search	**7**

Textbooks:

1. David A. Grossman, Ophir Frieder, Information Retrieval – Algorithms and Heuristics, Springer, 2nd Edition(Distributed by Universal Press), 2004

References :

1. Gerald J Kowalski, Mark T Maybury Information Storage and Retrieval Systems: Theory and Implementation, Springer, 2004.

2. SoumenChakrabarti, Mining the Web : Discovering Knowledge from Hypertext Data, Morgan – Kaufmann Publishers, 2002.

3. Christopher D Manning, PrabhakarRaghavan, HinrichSchutze, An Introduction to Information Retrieval By Cambridge University Press, England, 2009

AID510 : Employability Skills – (Project based learning) Level I							
Ver 1.0, Program Core, School of Technology							
Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	Weightage	Pass %
-	-	4	2	Practical	FEP	50	40
					POE	50	40

Prerequisite: Computer programming Language, Database Concepts, software engineering concepts, Operating System Concepts, Computer Network Concepts.

Course Outcomes: After the end of this course students will be able to

CO1 **Design**^{3} a mathematical model to solve the real time computational problems.

CO2 **Apply**^{3} programming skills to convert selected approach to working software.

Contents

The Project work should be carried out by using free and Open source software. The student is supposed to choose a specific domain in which he/she would like to develop the expertise. The student should identify the relevant problem and propose the solution, which can be implemented as a mini-project using suitable technology.

Student need to maintain a Project Diary and update the project progress, work reports in the project diary. Every student must submit a detailed project report in the format provided by the department. Periodic internal review shall be conducted which is evaluated by panel of examiners. The mini project work will be evaluated in the mid and end of the semester during which the group should give presentation and demonstration of their work done.

Evaluation of the mini project will be based on the following criteria:

Originality and Novelty
Project Scope, Objectives and Deliverables
Understanding of the Project Concept
Output of Results and Proper Documentation
Final Reports and Presentations

Two hours per week per batch practical is to be utilized for project work. The student should follow following sequence of activities :

1. Project topic and title finalization.
2. Submission of proposal for project work (Synopsis).
3. First presentation which includes a) Requirements analysis b) Architecture c) Data design

d) Algorithm design e) Module identification

4. Second presentation.
5. End Semester Review in 3rd Presentation (after 100 % implementation of all modules).
6. Project report preparation.

Textbooks:

1. Pankaj Jalote, *Software Engineering* : *A precise Approach*, Wiley India, 2010.

References :

2. Paul Cobbaut, *Linux Fundamentals*, CEST, 2015.

AID512: Laboratory III							
Ver 1.0, Program Core, School of Technology							
Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	Weightage	Pass %
-	-	4	2	Practical 100 Marks	FEP	50	40%
					POE	50	40%

Prerequisite: Statistics, R Programming, Python , MATLAB/ SCILAB

Course Description: This course gives an exposure to the implementation of different lab assignments on the topics of statistical learning and optimization techniques in detail

Course Objectives:

i. To familiarize students with fundamental concepts of Statistical analysis.
ii. To discuss the principles of different optimization techniques
iii. To frame engineering minima maxima problems in the framework of optimization problems.

Course Outcomes: After the end of this course students will be able to

CO1 **Interpret**[5] the results of different Classification & Regression techniques.
CO2 **Examine**[4] efficient computational procedures to solve optimization problems

Practical

Two hours per week per batch practical is to be utilized for writing programs to ensure that students have properly learnt the topics covered in the lectures. It should comprise of minimum 10-12 experiments. Students of different batches should implement different programs based on the following guidelines-

1. Implementation of classification.
2. Create a model and compare the Classification models and tree ensembles.
3. Exploratory Analysis of data using any tools.
4. Implementation of various regression model.
5. Cross-validation and Bootstrap.
6. Subset Selection with different methods.
7. Unconstrained optimizations
8. Constrained Optimization
9. Linear Programming
10. Quadratic Programming
11. Nonlinear Programming
12. Steepest descent method

Textbooks:

1. An Introduction to Statistical Learning with application in R, Gareth Games, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer Publication.
2. Introduction to Optimization, Edwin K. P. Chong, Stanislaw H. Zak-An, Wiley India

Publication

References:

1. The Elements of Statistical Learning Trevor Hastie, Robert Tibshirani ,Jerome Friedman

AID514: Laboratory IV							
Ver 1.0, Program Core, School of Technology							
Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	Weightage	Pass %
-	-	4	2	Practical 100 Marks	FEP	50	40%
					POE	50	40%

Prerequisite: Data Structures, Python, R Programming, MATLAB/ Scilab

Course Description: This course is intended for mastering knowledge and skills necessary for successful start of professional activity in the domain of Deep Learning. The course provides necessary knowledge in the domain of Pattern Recognition and Advanced Image Processing.

Course Objectives:

i. To develop an understanding of various basic concepts associated with Deep Learning.
ii. To impart knowledge of different Pattern Recognition techniques with K-NN Classifier and segmentation.
iii. To discuss designing and testing Deep Learning solutions with R Programming.

Course Outcomes: After the end of this course students will be able to

CO1 **Implement**[3] Deep Learning programs for various Neural Networks.

CO2 **Interpret**[5] relevant information to design a simple pattern recognition systems.

Practical

Two hours per week per batch practical is to be utilized for writing programs to ensure that students have properly learnt the topics covered in the lectures. It should comprise of minimum 10-12 experiments. Students of different batches should implement different programs based on the following guidelines-

1. Implementation of a feed-forward Neural Network from scratch
2. Multilayer Perceptron.
3. Convolutional Neural Network (Lenet)
4. Stacked Denoising Autoencoders (SdA).
5. Deep Belief Networks.
6. Recurrent Neural Networks with Word Embeddings.
7. LSTM Networks for Sentiment Analysis
8. Numerical and Theoretical problem
9. Implement the k-NN classifier for an unknown image and for a general K value.
10. Hand written document, Perform preprocessing and try to segment into characters
11. Integral images and Haar-like features.
12. AdaBoost and Classifier construction

Textbooks:

3. An Introduction to Statistical Learning with application in R, Gareth Games, Daniela

Witten, Trevor Hastie, Robert Tibshirani, Springer Publication.

4. Introduction to Optimization, Edwin K. P. Chong, Stanislaw H. Zak-An, Wiley India Publication

References:

2. The Elements of Statistical Learning Trevor Hastie, Robert Tibshirani ,Jerome Friedman

AID601 : Mini Project – (Project based learning) Level II							
Ver 1.0, Program Core, School of Technology							
Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	Weightage	Pass %
-	-	8	4	Practical	FEP	50	40
					POE	50	40

Prerequisite: Computer programming Language, Database Concepts, software engineering concepts, Operating System Concepts, Computer Network Concepts.

Course Outcomes: After the end of this course students will be able to

CO1 **Design**[3] a mathematical model to solve the real time computational problems.

CO2 **Apply**[3] programming skills to convert selected approach to working software.

Contents

The Project work should be carried out by using free and Open source software. The topic of the project should be connection with the domain selected in the course Employability Skills – (Project based learning) : Level I. The student should identify the relevant problem and propose the solution, which can be implemented as a mini-project using suitable technology.

Student need to maintain a Project Diary and update the project progress, work reports in the project diary. Every student must submit a detailed project report in the format provided by the department. Periodic internal review shall be conducted which is evaluated by panel of examiners. The mini project work will be evaluated in the mid and end of the semester during which the group should give presentation and demonstration of their work done.

Evaluation of the mini project will be based on the following criteria:

Originality and Novelty
Project Scope, Objectives and Deliverables
Understanding of the Project Concept
Output of Results and Proper Documentation
Final Reports and Presentations

Two hours per week per batch practical is to be utilized for project work. The student should follow following sequence of activities :

1. Project topic and title finalization.
2. Submission of proposal for project work (Synopsis).
3. First presentation which includes a) Requirements analysis b) Architecture c) Data design d) Algorithm design e) Module identification
4. Second presentation.

5. End Semester Review in 3rd Presentation (after 100 % implementation of all modules).
6. Project report preparation.

Textbooks:

2. Pankaj Jalote, *Software Engineering* : *A precise Approach*, Wiley India, 2010.

References :

3. Paul Cobbaut, *Linux Fundamentals*, CEST, 2015.

AID603: Open Elective (Self Learning)							
Ver 1.0, University Elective, School of Technology							
Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	Weightage	Pass %
4	-	-	4	Theory 100 Marks	FET	100	40

Course Outcomes: After the end of this course students will be able to

CO1 **Develop**[3] self-learning skills.

CO2 **Demonstrate**[3] theoretical knowledge required for project implementation.

Instructions

- Student shall register for the 4-credit course offered by authorized institutions/Agencies, through online with the approval of Head of the Department. Allowed MOOC courses agencies are NPTEL/ SWAYAM/ EDX/Coursera only.
- The Head of the Department shall appoint one mentor for MOOC subject opted and the mentor shall monitor the progress. The student shall submit an application not later than one week prior to the scheduled normal date of semester registration to the Head of the Department (HoD) giving the following details : Course Title, Agency Offering MOOC, Examination system and Credits of the Course, Timing and duration of course and its examination, centres of conducting of examination.
- On receipt of the application, the HoD shall forward the course details for aapproval to the DPGC committee. This committee shall examine the proposal in detail regarding course contents, examination system, suitability of the course and equivalence of course as per the Institute norms and give its recommendations for approval or non-approval including any special conditions to be imposed. Fees and other charges, if any, payable to MOOC certification agency shall be borne by concerned student at his/ her own level.
- The student shall submit the original certificate issued by MOOC authorities along with a photocopy of the same to the Department. The original will be returned after verification. Verification shall be certified by the HOD on the photocopy which shall be kept in records.

AID605: Dissertation Phase I							
Ver 1.0, Project work, School of Technology							
Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	Weightage	Pass %
-	-	12	6	Presentation, Report & Demo 100 Marks	FEP	100	40

Guidelines

1. A student is expected to carry out intensive literature survey/ identification of a major issue or problem in case of industry projects with observations and discussions in the area of interest specific to the domain in consultation with the dissertation supervisor and industry co- supervisor. The objectives and scope of the dissertation will be expected at a higher level.

2. A student is required to submit the dissertation synopsis duly signed by supervisor and co- supervisor to the M. Tech Co- coordinator of the department who schedules the synopsis presentation seminar in the DPC (Departmental Program Committee).

3. The dissertation synopsis seminar presentation comprises of the following details:
   - o Dissertation titles
   - o General introduction to the area of the topic
   - o Relevance of the dissertation work
   - o Literature review/ prior work done in the area
   - o Dissertation objectives and scope
   - o Expected outcomes
   - o Methodology
   - o Phases of work and representation on a Gantt chart with deadlines
   - o Resources required to complete the work
   - o Commitment from the student (Ethical conduct)
   - o References

4. Based on the report and the presentation, the DPC will give approval to the dissertation/ give suggestions/ suggest changes/modifications, additional scope, etc. specific to make dissertation to come to the expected level of PG requirement. The student will incorporate the suggestions and resubmit the same for approval.

5. The final copy of the synopsis with approval seal will be issued to the student, supervisor and the co- supervisor of the company which becomes the guiding document for the dissertation.

AID607: Dissertation Phase II							
Ver 1.0, Project work, School of Technology							
Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	Weightage	Pass %
-	-	12	6	Presentation& Report	FEP	50	40
					ESE	50	40

Guideline

1 Followed by approval of the synopsis, this phase aims at completing at least 40 % of the dissertation work specified in the synopsis. Phase II evaluation consists of a progress review based on the efforts put in by the student to carry out the work and results obtained thereof to seek suggestions and improvements and to ascertain that the student is going in the right direction.

2 This phase consists of both the In- semester evaluation by the supervisor and DPC and the end semester evaluation (consisting of presentation followed by demonstration) by a panel of examiners appointed by the COE of the university based on the panel of experts approved by BOS submitted to the COE.

3 Followed by approval of the synopsis, this phase aims at completing at least 40 % of the dissertation work specified in the synopsis. Phase II evaluation consists of a progress review based on the efforts put in by the student to carry out the work and results obtained thereof to seek suggestions and improvements and to ascertain that the student is going in the right direction.

4 This phase consists of both the In- semester evaluation by the supervisor and DPC and the end semester evaluation (consisting of presentation followed by demonstration) by a panel of examiners appointed by the COE of the university based on the panel of experts approved by BOS submitted to the COE.

AID602 Dissertation Phase III							
(Ver 1.0, Project Work, School of Technology)							
Lecture	Tutorial	Practical	Credits	Evaluation Scheme			
				Component	Exam	WT	Pass %
-	-	16	8	Presentation	FEP	100	40

Guideline

1 This stage marks the final progress review which indicates the completion of all the defined phases of the dissertation satisfactorily on the periodic progress reviews by supervisor and co- supervisor. A student by this time has used an opportunity to present his dissertation work in a reputed international/national conference to receive the feedbacks/ comments on the work and any new dimension to be incorporated to make the work novel and worthy of publishing in peer reviewed journals and should also prepare a journal paper based on the complete work of dissertation with results, discussions and conclusions.

2 A student is required to prepare the draft dissertation report as per the format of the university and with approval of supervisor and co- supervisor submit the same to the PG program coordinator of department.

3 The Program coordinator will schedule the presentation of student (Pre-submission) before the DPGC members once the student has completed all the academic requirements for the prescribed program.
1. Submission of Draft Dissertation Report
2. Completion of internship
3. Completion of the online/self-study.
4. Earning 100% credits of Sem I to III
5. Proof of presentation of the work in the International Conference (Certificate publication and draft paper in a template for an identified journal/uploading of same in peer reviewed journal)

4 Based on the recommendation of DPC, the dissertation is processed further. Viva-Voce examination is to be scheduled preferably with the same external expert appointed for the Dissertation Phase II by COE.

5 The successful completion of the Viva- voce, the panel of examiners recommends the candidate as successfully completed and submits the evaluation in the sealed envelope.

AID604 Dissertation Phase IV							
(Ver 1.0, Project Work, School of Technology)							
Lecture	Tutorial	Practical	Credits	Evaluation Scheme			
				Component	Exam	WT	Pass %
-	-	16	8	Viva Voce Exam	ESE	100	40

Guideline

1 If the DPC committee is of the opinion that a student is required to work further to achieve the stated objectives and incorporate some additional work, an extension based on the work is given to the student to complete the work and the student is required to re-submit the dissertation and a presentation is to be given to DPC. The DPC will take a final decision on whether to schedule the final exam or give additional extension of the work.

2 Participate and present a paper in a reputed national/ international conference organized by the premium institutions/ professional bodies. It is recommended to participate and publish in conferences whose proceedings are published by IEEE, Elsevier Springer, Materials Today or any other reputed conferences.

3 paper for a peer reviewed journal is to be prepared as per the journal format and uploaded to the journal website. It is desirable that at least the paper will be selected in initial review regarding Scope and it enters the second phase of editor

4 If the work of a student is novel and patentable in this case, a student need not have to bring his research findings in public domain through publication but he can file the patent. Student should be able to get provisional registration of patent with patent office.

5 In case of NDA with company when student is pursuing his dissertation, publication may not be possible in public domain. These cases are to be treated as special cases. A rubric is developed for evaluation.

6 The evaluation of the dissertation work of a student shall be carried out in four phases: First and third phase being evaluated for ISE by Department Post Graduate Committee (DPC) while second and fourth phase by DPGC for ISE and by a panel of examiners for ESE. Except for phase I evaluation i.e. evaluation based on synopsis submission seminar, a student shall be evaluated for all other phases for his/her understanding, the work done and his/her presentation followed by demonstration.

7 A panel of examiners for ESE shall consist of Chairman (who shall be one of the DPC members and shall monitor the process as per norms), an Internal Examiner (who shall be the Guide) and an External Examiner (who shall be a subject expert from outside the institute).