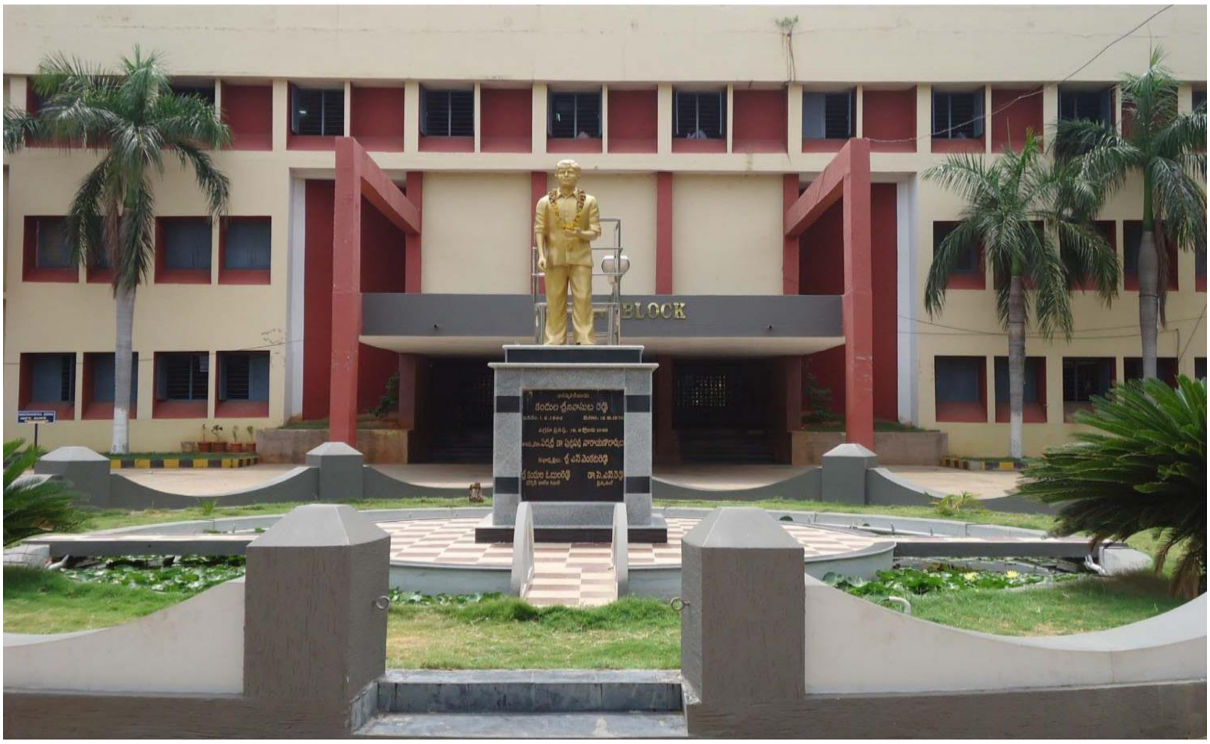
Regulations, Curriculum and Syllabus for

UG Programs in Engineering (R20UG)

(Effective from 2020-21 for Regular students and from 2021-22 for Lateral Entry students)

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & MACHINE LEARNING



Kandula Srinivasa Reddy Memorial College of Engineering
(Autonomous)
Kadapa 516005, AP
(Approved by AICTE, Affiliated to JNTUA, Ananthapuramu, Accredited by NAAC) (An ISO 9001-2008 Certified Institution)

KSRM COLLEGE OF ENGINEERING (AUTONOMOUS)
VISION & MISSION

VISION:

To evolve as center of repute for providing quality academic programs amalgamated with creative learning and research excellence to produce graduates with leadership qualities, ethical and human values to serve the nation.

MISSION:

M1: To provide high quality education with enriched curriculum blended with impactful teaching-learning practices.

M2: To promote research, entrepreneurship and innovation through industry collaborations.

M3: To produce highly competent professional leaders for contributing to Socio-economic development of region and the nation.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
VISION & MISSION

VISION:

To become a renowned department by offering industry need education with upgrading technology, nurturing collaborative culture & modelling the students in global professions with ethical and leadership sprit.

MISSION:

M1: To produce globally competent and qualified professionals in areas of AI & ML

M2: To impart knowledge in cutting edge Artificial Intelligence technologies in par with industrial standards.

M3: To inculcate leadership abilities in the young minds to implant commitment as work culture for the progress of the Nation

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

PEO1 - Technical & Employability skills: To prepare students to meet the industrial needs and embed the knowledge such that the students become enough efficient in the design and development of required software and create solutions for automation of real time scenarios throughout their career.

PEO2 - Leadership Quality: To instil confidence and train students in soft skills, leadership abilities in understanding the ethical and social responsibilities in their professional lives and to become successful entrepreneurs

PEO3 - Problem Solving: To enhance technical knowledge, using modern tools for the new technologies and advance professionally as a result of his/her ability to solve complex technical problems.

PEO4 - Professional Ethics: To prepare students work in multidisciplinary teams on problems whose solutions lead to significant societal benefit.

PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Program Outcomes:

PO1 - Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 - Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substaniated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 - Design/Development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 - Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 - Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6 - The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 - Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 - Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PO9 - Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 - Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions .

PO11 - Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 - Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES:

PSO1 - Develop an in-depth knowledge and skill set in human cognition, Artificial Intelligence, Machine Learning and data engineering for designing intelligent systems to address modern computing challenges

PSO2 - Evaluate, analyse and synthesize solutions for real time problems in Artificial Intelligence and Machine Learning domain to conduct research in a wider theoretical and practical context

PSO3 - Do innovative system design with analytical knowledge by developing modern tools and techniques

KSRM College of Engineering (Autonomous), Kadapa-516005, A.P.

Regulations for UG Programs in Engineering
(R20UG)
(Effective from 2020-21)

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KSRM College of Engineering (Autonomous), Kadapa-516005, A.P.

Regulations for UG Programs in Engineering

(R20 UG) (Effective From 2020-21)

1.0 Nomenclature

1.1 *Academic Year*: Period of academic instruction of, approximately, one year durationthat usually starts in June/July and ends in April/May next

1.2 *Semester*: Either of two divisions of an academic year

1.3 *Major*: A specific field of study. Example: Civil Engineering

1.4 *Minor*: An area outside of, or complementary to, a Major. Example: For CivilEngineering major, Computer Science is a minor and vice versa

1.5 *Subject*: An area of knowledge that is studied as part of a Course

1.6 *Core*: A subject that is mandatory for a Major course of study

1.7 *Elective*: A subject that is selected for study to suit one's individual needs

1.8 *Mandatory Subject*: A subject that is studied to meet certain requirements but has nocredits assigned to it

1.9 *Humanities subjects*: Subjects that describe and interpret human achievements, problems and historical changes at individual and societal levels covering the disciplines of literature, history, and philosophy.

1.10 *Social Sciences*: Subjects that describe the mental and behavioural activities of individuals, groups, organizations, institutions, and nations covering the disciplines of anthropology, economics, linguistics, political science, and psychology

1.11 *Exam*: A test to measure one's progress, knowledge, or ability in a subject

1.12 *Credit*: A numerical weight given to a subject, usually based on quantum of academic work

1.13 *Grade*: A numerical or alphabetic designation measuring the level of achievement in an exam.

1.14 *Attendance*: Physical presence of oneself in a classroom/laboratory for purpose of ascheduled academic instruction

1.15 *Course*: A series of subjects that constitute a Major field of study

1.16 *Branch*: Same as Course

1.17 *Program*: Same as Course

1.18 *Degree*: An academic title conferred to honour distinguished achievement

1.19 *Minor Degree*: An Academic honour conferred on achieving 20 extra credits in one'sminor area of study

1.20 *Honours*: An Academic honour conferred on achieving 20 extra credits in one'smajor area of study.

2.0 Short Title and Application

2.1 These rules and regulations may be called as R20UG and come into force from Academic Year 2020-21 and exists until superseded by new regulations. These rules are applicable for students who join the institute from academic year 2020-21 onwards. Students who have joined in earlier regulations will continue in their respective regulations.

2.2 These rules and regulations are applicable to all under graduate courses in engineering and technology leading to Bachelor's Degree in Technology (B. Tech)

2.3 The Major courses offered, at present, are:

2.3.1 Civil Engineering

2.3.2 Electrical and Electronics Engineering

2.3.3 Mechanical Engineering

2.3.4 Electronics and Communication Engineering

2.3.5 Computer Science and Engineering

2.4 The Institute may offer new Majors in future to which these rules and regulationswill be applicable.

3.0 Suspension and Amendment of Rules

3.1 Academic Council has the authority to suspend a rule temporarily.

3.2 Academic Council has the authority to amend a rule.

3.3 For affirmative action on any suspension or amendment of a rule, an affirmative vote of three-fifths of the members present and voting shall be required in Academic Council.

4.0 Requirements for Admission

4.1 At present, admissions into first-year class of various Majors are governed by Government and the Affiliating University. The eligibility criteria and procedure for admissions are prescribed by Government and Affiliating University.

4.2 A student is not allowed change of Major after admission into first-year.

4.3 A student must fulfil medical standards required for admission.

4.4 The selected students are admitted into first-year class after payment of the prescribed fees.

5.0 Structure of the B. Tech course

5.1 *Duration*: The duration of B. Tech degree course is eight semesters spread over fouracademic years. Semesters are named sequentially from First Semester to Eighth Semester.

5.2 *Working Days*: Calendar for any semester shall be announced at least four weeks before its commencement. Minimum number of working days shall be 90 for any semester.

5.3 *Curriculum*: Each major shall have core, elective and mandatory subjects drawn from six categories of subject areas - i) Basic Sciences (BSC), ii) Humanities and Social Sciences including Management Courses (HSMC), iii) Engineering Science Courses (ESC), iv) Professional Core Course (PCC), v) Professional Elective Course (PEC), and vi) Open Elective Course (OEC). The curriculum for eachbranch shall be approved by its corresponding Board of Studies and Academic Council.

5.4 *Credits*: All subjects that are assessed for marks have credits assigned to them. Thecredits assigned to subjects shall be given in curriculum. The total number of creditsfor entire course is 160 for all branches.

5.5 *Curriculum and Syllabus*: The curriculum and syllabus for first and second semestersis given in Annexure-1 and Annexure-2 respectively.

5.6 *Medium of Instruction*: The medium of instruction, examinations and all other related activities is English.

5.7 *Responsibility and Advising*: It is the responsibility of the student to understand and know the regulations and requirements to earn the degree. Each student admitted into the degree programs is assigned to a Faculty Advisor who assists the student indesigning an effective program of study. Students should consult their Faculty Advisors for selection of electives and for general advice on academic program.

5.8 *Gap-Year*: Outstanding students who wish to pursue entrepreneurship are allowedto take a break of one year at any time after II Year / III Year to pursue entrepreneurship full time. This period shall be counted for the maximum time for graduation. College Academic Council shall evaluate the proposal submitted by the student and decide on permitting the student for availing the gap-year. Gap- year can be availed once in the entire course.

6.0 Registration and Enrolment

6.1 Prior to start of each semester, every student shall register for all the subjects listedin curriculum and additional subjects required for achieving honours/ minor degree. Excepting first semester, the registration for a semester shall be done duringa specified week after end examinations of previous semester. In first semester, theregistration shall be done within six working days from date of joining. Recommendation of Faculty Advisor is needed for registration.

6.2 A student can register utmost 8 theory subjects, including mandatory subjects, in any semester.

6.3 Late registration will be permitted with a fine, decided from time to time, up to sixworking days from the last date specified for registration.

6.4 A student will be eligible for registration for a semester if she or he i) is promoted tothat semester, ii) has cleared all fees to the Institute, library and hostel of previoussemester, and iii) is not disqualified for registration by a disciplinary action.

6.5 A student will be enrolled and allowed to attend the classes on successful registration and payment of necessary fees to Institution, library, and hostel.

6.6 Registration and enrolment will be controlled by the Office of the Controller of Examinations.

7.0 Assessment Procedure – Internal Tests and End Examinations

7.1 Performance of students in all subjects is assessed continuously through assignments, internal assessment tests and an End examination.

7.2 Allocation of internal assessment and End examination marks

7.2.1 For theory subjects, the allocation is 40 marks for internal assessment and60 marks for End examination totalling 100 marks.

7.2.2 For laboratory/drawing/project work subjects, the allocation is 40 marks forinternal assessment and 60 marks for End examination totalling 100 marks.

7.2.3 For seminar/industrial training/internship subjects, the allocation is 100 marks for internal assessment. There is no end examination for these subjects.

7.2.4 For mandatory subjects the allocation is 40 marks for internal assessment and no allocation for End examination. These marks are specified for purpose of clause 9.3, and do not account for any credits.

7.3 Internal Assessment

7.3.1 Internal assessment means performance evaluation of students by faculty members who teach the subjects.

7.3.2 *Guidelines*:

a) *Allocation*: For theory subjects including mandatory subjects the total internal assessment marks is 40 of which 30 marks are assessed through midterm tests, 5 marks by surprise or sudden quiz and 5 marks by assignments. The faculty members of the concerned subject will assess themarks in the midterm tests and assignments.

b) *Midterm tests*: Each midterm test will be of 90 minutes duration and evaluated for 30 marks. Internal assessment marks for midterm tests will be calculated as weighted sum of the two midterm test marks, with 80% weight for the best and 20% weight for the other marks. Internal assessment marks for assignments is calculated as the average of all assignments. Total internal marks are the sum of midterm tests, surprise orsudden quiz and assignments assessment marks.

If any student abstains for any midterm test, she or he will be awarded zeromarks for that midterm test. If any student fails to submit any assignmentwithin the specified deadline, she or he will be awarded zero marks for thatassignment.

i. *Number and duration*: There shall be two midterm tests each with a duration of 90 minutes.
ii. *Format of test and division of marks*: Internal test shall consist of only descriptive part for 30 marks.
iii. *Descriptive or Subjective part*: Subjective part shall contain three questionsand all questions shall be answered. However, each question can have internal choice (either or type question). Generally, each question shall testone Course Outcome (CO).
iv. *Syllabus*: Each test shall cover 50% of the syllabus, approximately.

c) *Assignments*: The assignments shall aid and hone the daily routine of students. Assignments shall be stimulating and thought provoking to the student. Whilesome questions may test student's understanding of the subject, there shall bequestions that imply connect to real world applications. A variety of questionscan posed in assignments.

i. *Number:* A minimum of four assignments shall be given in each subject with one assignment from Unit I to IV of syllabus of that subject.
ii. *Quantum of work*: An assignment shall take about four to six hours of study / work per week. Assignments shall not be overloaded nor under loaded. As a guideline, each assignment may contain five questions, each question taking an hour to answer.
iii. *Marks*: Each assignment must be evaluated for fifty marks. Final marks areobtained by averaging all the assignment marks and reducing it to five marks.
iv. *Deadlines*: Students shall be given at least one-week time to complete and submit assignments. Assignments shall be submitted within deadline. Latesubmissions should be awarded zero marks.
v. *General*: It is advised to administer assignments using Google Classroom.

d) *Quiz*: The concerned faculty has to conduct 8 surprise quiz exams in the regular class itself. From each unit two quiz exams shall be conducted and each quiz is for 10 marks. Out of 8 quizzes 6 best quizzes shall be considered and average of 6 quizzes will be reduced to 5 marks. Each quiz can be fill in the blanks or single sentence answer or definitions.

7.3.3 For laboratory/practical/drawing subjects, the internal assessment will be based on regular laboratory work over full semester. The assessment will bedone by the faculty concerned. The students shall be informed sufficiently early of the procedure to be followed for internal assessment.

7.3.4 For subjects like seminar, project-work, industrial training/internship, andcomprehensive viva-voce, the internal assessment will be done by a Department Committee consisting of two senior faculty members and faculty guide of concerned student. The assessment procedure will be informed sufficiently early to the students.

a) *Mandatory internships*: University Guidelines shall apply.
b) *Evaluation of internships*: Shall be evaluated through the departmental committee. A student will be required to submit a summer internship report to the concerned department and appear for an oral presentation before the department committee. The report and the oral presentation shall carry 40% and 60% weightages respectively.
c) *Final Semester Internship*: A student should mandatorily undergo internship (University Guidelines shall apply) and should work parallelly on a project. At the end of the semester the candidate shall submit an internship completion certificate and a project report. The project report shall be evaluated with an external examiner.

7.3.5 After the course work is over, the student is permitted to improve his/her internal marks of any 3 theory subjects in the entire course. However he/she will have to attend the course work.

7.4 End examinations

7.4.1 End examinations shall be conducted after completion of coursework in each semester. End exams assessment is for 60 marks. The question paper contains 5 questions and all questions shall be answered. Each question have internal choice (either or type question). Each question carries 12 marks.

7.4.2 The question papers for theory subjects shall be set by faculty members outside of the Institute. The external faculty members for question paper setting shall be appointed by the Principal.

7.4.3 Evaluation of answer scripts shall be done by either Internal or External examiners appointed by the Principal. A minimum of 50% of subjects will beevaluated by external examiners.

7.4.4 For laboratory subjects, end examination shall be conducted by a committee consisting of two internal examiners. One examiner shall be appointed by Head of Department of concerned Major, and the other examiner shall be appointed by the Principal.

7.4.5 For project work viva-voce, end examination shall be conducted by a committee consisting of one internal examiner, one external examiner, and the concerned guide of the student. Internal examiner shall be appointed by Head of Department of concerned Major, and the external examiner shall be appointed by the Principal.

7.4.6 If a student abstains from End examination of any subject, for any reason, sheor he shall be marked as "ABSENT" in that subject.

7.4.7 There is no end examination for mandatory subjects.

8.0 Method of Assigning Letter Grades and Grade Points

8.1 For all credit-bearing subjects, performance of a student in a subject is indicated bya letter grade that corresponds to absolute marks earned in that subject. Each lettergrade is assigned a numeric Grade Point that is used to compute Grade Point Average on a scale of 0 to 10.

8.2 Performance of a student in both internal assessment and End examination will beconsidered for awarding grades for credit bearing subjects. Total marks earned in asubject is the sum of marks obtained in internal assessment and End examination in that subject.

8.3 Pass grade S to E is assigned to a subject based on total marks earned in that subject provided that a student earns at least i) 35% of marks in End examination,and ii) 40% of marks in internal assessment and End examination put together; otherwise fail grade F will be assigned to that subject.

8.4 Grade I will be assigned to a subject if a disciplinary action is pending and is not resolved before publication of results. Office of Controller of Examinations shall resolve the pending disciplinary action within six working days from the date of publication of results and change the grade to any of S to F.

8.5 Grade *Ab* will be assigned to a subject if a student abstains for End examination ofthat subject.

8.6 The absolute marks and corresponding letter grade and grade points are given in Table 1.

Table 1: Letter Grades and Grade Points

Absolute Marks	Letter Grade	Grade Points assigned	Remark
$\geq$ 90	S (Outstanding)	10	Pass
80 - 89	A (Excellent)	9	Pass
70 - 79	B (Very Good)	8	Pass
60 - 69	C (Good)	7	Pass
50 - 59	D (Average)	6	Pass
40 - 49	E (Below Average)	5	Pass

< 40	F (Fail)	0	Fail
Absent	Ab (Absent)	0	Fail
-	I	0	Result Withheld

8.7 *SGPA*: Semester Grade Point Average indicates the performance of a student in allcredit-bearing subjects of a semester. SGPA is calculated as the weighted average ofGrade Points of all subjects of the semester with corresponding credits of subjects as weights. Audit and Self-study subjects are not considered for SGPA calculation

$$SGPA = \frac{\sum GP_i \times CR_i}{\sum CR_i}$$

where GP_i = Grade Point earned in a subjectand CR_i = Credits allocated for that subject

8.8 *CGPA*: Cumulative Grade Point Average indicates the performance of a student in all semesters up to and including the current semester under consideration. CGPAis calculated as the weighted average of SGPAs with total credits in each semester as the weights.

$$CGPA = \frac{\sum S_i \, X \, TC_i}{\sum TC_i}$$

where S_i = SGPA obtained in a semesterand TC_i = Total Credits for that semester

8.9 As per AICTE regulations, conversion of CGPA into equivalent percentage is asfollows:

Equivalent Percentage = (CGPA – 0.50) □ 10

8.10 In *SGPA / CGPA* calculations credits earned towards honours / minor degree will not be counted.

8.11 *Grade Card*: All students shall be issued Grade Cards after the publication of results of a semester. Grade Card is a statement of performance of a student in a semester.It contains information about each registered subject: type of subject, allocated credits, and letter grade earned. SGPA and CGPA will also be indicated.

9.0 Requirements for Completing Subjects

9.1 A student shall complete all credit-bearing and mandatory subjects successfully tobe eligible for award of degree.

9.2 *Credit-bearing subjects*: A student is considered to have completed a credit-bearing subject successfully and earned credits if she or he obtains a pass grade from S to Ein that subject. If a student receives fail grade F or *Ab* in any subject, she or he mustregister for supplementary End examination for that subject as and when opportunity arises and improve grade to pass grade.

9.3 *Mandatory subjects*: A student is considered to have successfully completed a mandatory subject if she or he earns at least 40% of internal assessment marks in that subject.

9.4 *Supplementary exam for mandatory subjects*: If a student fails in mandatory subject, she or he shall register for supplementary examination in that subject as and when theopportunity arises and pass that subject. The supplementary exam will be conducted for 30 marks covering the entire syllabus and student is deemed to havepassed in the subject if she or he earns 12 marks (40% marks) in the supplementaryexam, disregard of her or his performance in assignments and internal tests.

10.0 Requirements for taking End Examinations and Promotion

10.1 A student is eligible to take regular End Examinations of current semester if she orhe fulfils the attendance requirement.

10.2 A student shall be promoted from current semester to succeeding semester onsatisfying the attendance and total credits-earned requirements.

10.3 Attendance Requirement

10.3.1 Attendance of students shall be recorded for credit-bearing and mandatory subjects as per the work load indicated in curriculum.

10.3.2 Total class-periods conducted shall be reckoned from beginning to end of asemester as published in academic calendar.

10.3.3 Aggregate Percentage of Attendance is calculated using total number of class-periods attended as numerator and total number of class-periodsconducted for the concerned semester as the denominator.

10.3.4 A minimum aggregate attendance of 75% is required for promotion to succeeding semester and be eligible to take End examinations of current semester. In addition, student has to acquire a minimum of 40% attendancein each subject.

10.3.5 A student can appeal to the Principal for condoning deficiency in aggregate attendance if she or he gets an aggregate attendance of 65% or more but lessthan the required 75%, presenting a valid reason for deficiency. Such a student will be granted promotion if the Principal pardons the deficiency. Principal has the right to reject the appeal if he/she is not satisfied with theperformance of the student or the reason cited for deficiency of the attendance.

10.3.6 A student earning less than 65% aggregate attendance will be denied promotion. A student who is not promoted on basis of attendance shall be removed from the rolls and shall register for the same semester when opportunity arises. The current semester record of the student is cancelled automatically.

10.4 Credits-Earned Requirement

10.4.1 This rule is applicable for promotion of a student from fourth semester to fifth semester and from sixth semester to seventh semester.

10.4.2 A student who is denied promotion for want of requisite credits shall take supplementary examinations, as and when offered, and earn credits to be eligible for promotion.

10.4.3 Subjects registered for honours/minor degree shall not be considered towards credits-earned requirement.

10.4.4 For promotion from fourth semester to fifth semester, a student must earn atleast 40% credits (rounded to lower integer) from first semester to third semester subjects. A student will get the following opportunities to pass thesubjects:

First semester subjects	: One regular and three supplementary exams
Second semester subjects	: One regular and two supplementary exams
Third semester subjects	: One regular and one supplementary exam

10.4.5 For promotion from sixth semester to seventh semester, a student must earnat least 40% credits (rounded to lower integer) from first semester to fifth semester subjects. A student will get the following opportunities to pass thesubjects:

First semester subjects	: One regular and five supplementary exams
Second semester subjects	: One regular and four supplementary exams
Third semester subjects	: One regular and three supplementary exams
Fourth semester subjects	: One regular and two supplementary exams
Fifth semester subjects	: One regular and one supplementary exam

11.0 Revaluation of End Examination Scripts

11.1 Revaluation of End Examination scripts is allowed for theory subjects only by paying requisite fee.

11.2 Procedure for Revaluation: The script will be revaluated by an examiner appointed by the Principal. The maximum of revaluation and regular end examination markswill be awarded for that subject.

11.3 A student can apply for revaluation in a subject only once.

12.0 Supplementary End Examinations

12.1 Students are eligible to take Supplementary examinations in subjects with fail gradeeither F or *Ab* only.

12.2 Supplementary examinations for even semester subjects will be conducted along with regular examinations of odd semester subjects.

12.3 Supplementary examinations for odd semester subjects will be conducted along with regular examinations of even semester subjects.

12.4 For eighth semester, special supplementary examinations will be conducted in second week following the results publication date of regular examination of eighthsemester.

13.0 Requirements for Award of B. Tech degree

13.1 Time Limit for completion of requirements for award of degree is eight academic years including gap-year from the date of admission. A student who could not complete all the requirements in this time limit shall forego admission and will beremoved from the rolls of the Institute.

13.2 A student shall be eligible for award of B. Tech degree provided she or he has:

13.2.1 Registered and successfully completed all required credit-bearing and mandatory subjects with a total of 160 credits

13.2.2 Secured a CGPA of 4.5 or more

13.2.3 Cleared all dues to the Institute, library and hostel

13.2.4 No disciplinary action is pending against her or him

13.2.5 Satisfied any other stipulation of the affiliating university.

13.3 *Award of Class*: Each student will be given class in degree based on CGPA asfollows:

Table 2: Class of Degree

Class of Degree	Range of CGPA
Pass Class	>= 4.5 but <5.5
Second Class	>= 5.5 but <6.5
First Class	>= 6.5 but <7.5
First Class with Distinction	>= 7.5

13.4 *Degree with Honours designation*: Students with higher learning capabilities are encouraged to opt for Honours designation. Degree with Honours imply a higher level of academic achievement. A student can earn B.Tech degree with honours designation by meeting the following requirements

13.4.1 Honours designation is optional. A student can opt for either Honours designation or Minor degree (clause 13.5) but not both.

13.4.2 *Entry eligibility*: Students shall apply for Honours designation at the beginning of the fourth semester. Eligibility criteria are (i) minimum CGPA of 8.0 and (ii) no backlogs, reckoned up to second semester.

The Chairperson of the concerned Board of Studies will process the applications and publish the list of eligible students.

13.4.3 *Additional course work*: Students shall complete an additional 20-credits coursework, in addition to 160 regular credits, in her/his own major during fifth to seventh semesters. The Board of Studies (BoS) of the concerned major shall specify the list of advanced elective subjects for the purpose of honours designation.

Out of the 20 additional credits to be acquired, 16 credits shall be earned by undergoing specified courses listed as pools, with four courses, each carrying 4 credits. The remaining 4 credits must be acquired through twoMOOCs, which shall be domain specific, each with 2 credits and with a minimum duration of 8/12 weeks as recommended by the BoS.

If minimum enrolments criteria are not met then the students shall be permitted to register for the equivalent MOOC courses as approved by theconcerned Head of the department in consultation with BoS.

If a student drops or is terminated from the Honours program, the additional credits earned so far will remain extra. These additional courses will find mention in the transcript but not in the degree certificate.

13.4.4 *Registration and enrollment*: Clause 6.0 shall apply

13.4.5 *Evaluation*: The evaluation shall be as per clause 7.0

13.4.6 *Continuous performance*: Students shall earn a minimum SGPA of 8.0 in allsemesters, from fourth to seventh, and without backlogs to be eligible for award of Honours designation. Regular and additional subjects shall be considered for SGPA calculation. If a student does not get a minimum SGPA of 8.0 or fails in any subject during fourth to seventh semesters, she/he will lose candidature for honours designation.

13.5 *Minor Degree designation*: Students with higher learning capabilities are encouraged to opt for Minor degree designation. Minor degree imply a higher level of academic achievement and improves employability. A student can earn minor degree designation by meeting the following requirements.

13.5.1 Minor degree is optional. A student can opt for either Minor degree or Honours designation (clause 13.4) but not both.

13.5.2 *Entry eligibility*: Students shall apply for minor degree at the beginning of fourth semester. Eligibility criteria are (i) minimum CGPA of 8.0 and (ii) no backlogs, reckoned up to second semester. The Chairperson of the concerned Board of Studies (minor department) will process the applications and publish the list of eligible students.

13.5.3 *Additional coursework*: Students shall complete an additional 20-credits coursework, in addition to 160 regular credits, in selected minor program during fourth to seventh semesters. The Board of Studies (BoS) of the concerned minor program shall specify the list of core and elective subjects for the purpose of minor degree. Out of the 20 credits, 16 credits shall be earned by undergoing specified courses listed by the concerned BoS and must pursue atleast 2 courses through MOOCs.

13.5.4 *Registration and enrollment*: Clause 6.0 shall apply.

13.5.5 *Evaluation*: The evaluation shall be as per clause 7.0.

13.5.6 *Continuous performance*: Students shall earn a minimum SGPA of 8.0 in all semesters, from fourth to seventh, and without backlogs to be eligible for award of minor degree. Regular and additional subjects shall be considered for SGPA calculation. If a student does not get a minimum SGPA of 8.0 or fails in any subject during fourth to seventh semesters, she/he will lose candidature for minor degree.

13.6 Degree will be issued under the seal of affiliating University.

14.0 Regulations for Lateral Entry Students under R20 UG

Title and application: These rules and regulations may be called R20UG-LE and come into force from academic year 2021-22 and exist in force until superseded by other regulations. These regulations are applicable to students admitted under lateral entry scheme leading to Bachelor’s Degree in Technology (B.Tech).

a) *Regulations and curriculum*: The regulations and curriculum of R20UG shall be applicable in general with the following modifications:
   i. *Entry and duration*: The students will be admitted directly into third semester of regular 4-year B.Tech degree course governed by R20UG regulations. The duration of the course is three academic years.
   ii. *Curriculum*: Third semester to eighth semester curriculum of R20UG.
   iii. *Promotion by credits-earned requirement*: This is applicable for the promotion of a student from sixth semester to seventh semester only. She/he must earn at least 40% of total credits (rounded to lower integer) from third to fifth semesters for promotion from sixth semester to seventh semester.

b) Requirements for the award of B.Tech degree:
   i. Time limit for completion of requirements for award of degree is six academic years from the date of admission.
   ii. Registered and successfully completed all required credit-bearing and mandatory subjects with a total of 121 credits. (third semester to eighth semester subjects)
   iii. *Honours/minors designation*: shall earn extra 20 credits in addition to 121 credits.

15.0 Transitory Regulations

A student who initially joins the Institute in a previous Regulation and has to re- join in a semester of the present Regulations, due to any reason, shall be bound by the rules of the current Regulations. Board of Studies of the concerned Major will specify, extra or otherwise, academic coursework to be undertaken by such students who join the current Regulations.

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

Course Structure

I Semester

S.No	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
1	2021101	Linear Algebra & Calculus	BS	3	-	-	40	60	3
2	2023103	Environmental Chemistry	BS	3	-	-	40	60	3
3	2039103	Problem Solving with Algorithmic thinking	ES	2	-	-	40	60	2
4	2024104	Professional Communication	HS	2	-	-	40	60	2
5	2039105	Python Programming	ES	3	-	-	40	60	3
6	2013106	Introduction to Digital Manufacturing	ES	2	-	-	40	60	2
7	20AG107	Agriculture for Engineers & Field Activity Lab	BS	-	-	3	40	60	1.5
8	2039108	Problem Solving using C Lab	ES	-	-	3	40	60	1.5
9	2039109	Python Programming Lab	ES	-	-	3	40	60	1.5
10	20MC110	Indian Traditional Knowledge	MC	3	-	-	40	-	-
Total							**400**	**540**	**19.5**

L - Lecture, T - Tutorial, P – Practical

II Semester

S.No	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
1	2023201	Biology for Engineers	BS	2	-	-	40	60	2
2	20AP202	Applied Physics	BS	2	-	-	40	60	2
3	2039202	Introduction to machine learning	ES	1	-	-	40	--	0
4	2039203	Data Structures	ES	3	-	-	40	60	3
5	2021204	Mathematics for Intelligent Systems	BS	2	-	-	40	60	2
6	2039205	Object Oriented Programming through Java	ES	3	-	-	40	60	3
7	2014206	Principles of Measurements & Sensors	ES	3	-	-	40	60	3
8	2039207	Data Structures Lab	ES	-	-	3	40	60	1.5
9	2024209	Communication Skills lab	HS	-	-	3	40	60	1.5
10	2039208	Java Programming Lab	ES	-	-	3	40	60	1.5
11	20MC211	Community work / NSS	MC	2	-	-	40	-	-
Total							**440**	**540**	**19.5**

III Semester

S.No	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
1	2021303	Probability and Optimization	BSC	3	0	0	40	60	3
2	2039302	Discrete Mathematics & Graph Theory	PCC	3	0	0	40	60	3
3	2039303	Digital Systems and Computer Organization	PCC	3	0	0	40	60	3
4	2039304	Introduction to Artificial Intelligence	PCC	3	0	0	40	60	3
5	2039305	RDBMS	PCC	3	0	0	40	60	3
6	2039306	**Skill Course – I** **(**MAT Lab Programming)	SC-I	1	0	2	40	60	2
7	2024310	Universal Human Values	HSMC	3	0	0	40	60	3
8	2039307	Digital Systems and Computer Organization Lab	PCC LAB	0	0	3	40	60	1.5
9	2039308	RDBMS Lab	PCC LAB	0	0	3	40	60	1.5
10	2039309	Exploratory Data Analysis with R	PCC LAB	0	0	3	40	60	1.5
Total							**400**	**600**	**24.5**

IV Semester

S.No	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
1	2025401	Business Economics and Accounting for Engineers	HSMC	3	0	0	40	60	3
2	2039402	Design and Analysis of Algorithms	PCC	3	0	0	40	60	3
3	2039403	Operating Systems	PCC	3	0	0	40	60	3
4	2039404	Data Science	PCC	3	0	0	40	60	3
5	2039405	Business Intelligence Analyst	PCC	3	0	0	40	60	3
6	2039406	Operating Systems Lab	PCC LAB	0	0	3	40	60	1.5
7	2039407	Data Science Lab	PCC LAB	0	0	3	40	60	1.5
8	2039408	Business Intelligence Analyst Lab	PCC LAB	0	0	3	40	60	1.5
9	2039409	**Skill Course – II** **(**Advanced Python Programming**)**	SC	1	0	2	40	60	2
10	20MC409	**Mandatory Course** **(**Constitution of India)	MC	2	1	0	40	---	0
Total							**400**	**540**	**21.5**

V Semester

S.No	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
1	2039501	Data Mining & Data Warehousing	PCC	3	0	0	40	60	03
2	2039502	Automata Theory & Compiler Design	PCC	3	0	0	40	60	03
3	2039503	Big Data Engineer (IBM)	PCC	3	0	0	40	60	03
4	2039504 2039505 2039506	**Professional Elective Course-I:** 1. Computer Networks 2. Image Processing 3. Web Technologies	PEC	3	0	0	40	60	03
5		**Open Elective-1**							
		Courses offered by: **Civil engineering**							
	20CE101	Disaster management	OEC-1	3	0	0	40	60	3
	20CE102	Basics of Civil Engineering	OEC-1	3	0	0	40	60	3
	20CE103	Building Materials	OEC-1	3	0	0	40	60	3
		Courses offered by: **Electrical and Electronics Engineering**							
	20OE201	Modern Control Theory	OEC-1	3	0	0	40	60	3
	20OE202	Programming Fundamentals for Numerical Computations	OEC-1	3	0	0	40	60	3
		Courses offered by: **Mechanical Engineering**							
	20OE301	Introduction to Hybrid and Electric Vehicles	OEC-1	3	0	0	40	60	3
	20OE302	Rapid Prototyping	OEC-1	3	0	0	40	60	3
	20OE303	Design for Manufacturing and Assembly	OEC-1	3	0	0	40	60	3
	20OE304	Energy Systems Engineering	OEC-1	3	0	0	40	60	3
	20OE305	Smart Materials	OEC-1	3	0	0	40	60	3
		Courses offered by: **Electronics and Communication Engineering**							
	20OE401	Overview of Microcontrollers	OEC-1	3	0	0	40	60	3
	20OE402	Industrial electronics	OEC-1	3	0	0	40	60	3
		Courses offered by: **Artificial Intelligence and Machine Learning**							
	20OE3901	Data Structures	OEC-1	3	0	0	40	60	03
	20OE3902	OOP through C++	OEC-1	3	0	0	40	60	03
		Courses offered by: **Humanities and Sciences**							
	20OE601	Employability Skills	OEC-1	3	0	0	40	60	03
	20OE602	Advanced Numerical Methods	OEC-1	3	0	0	40	60	03
	20OE604	Basics of Nanotechnology	OEC-1	3	0	0	40	60	03
	20OE605	Write it Right	OEC-1	3	0	0	40	60	03
	20OE606	Human Capital Management	OEC-1	3	0	0	40	60	03
	20OE607	Engineering Materials	OEC-1	3	0	0	40	60	03

6	2039507	Big Data Engineer Lab (IBM)	PCC LAB	0	0	3	40	60	1.5
7	2039508	Data Mining Lab	PCC LAB	0	0	3	40	60	1.5

8	2039509	**Skill Course-III:** Mobile App Development	SC	1	0	2	40	60	02
9	20MC510	**Mandatory Course:** Environmental Science	MC	2	0	0	40	---	00
10	2039510	Community Service Project	PROJ	0	0	3	100	---	1.5
		Total					**460**	**480**	**21.5**

VI Semester

S.No	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
1	2039601	Deep Learning	PCC	3	0	0	40	60	03
2	2039602	Software Engineering	PCC	3	0	0	40	60	03
3	2039603	Predictive Analytics Modeler (IBM)	PCC	3	0	0	40	60	03
4	2039604 2039605 2039606	**Professional Elective Course – II:** 1. Cryptography and Network Security 2. Cloud Computing 3. Computational Intelligence	PEC	3	0	0	40	60	03
5		**Open Elective-2**							
		Courses offered by: **Civil Engineering**							
	20CE104	Solid Waste Management	OEC-2	3	0	0	40	60	3
	20CE105	Estimation and Costing	OEC-2	3	0	0	40	60	3
	20CE106	Water management	OEC-2	3	0	0	40	60	3
		Courses offered by: **Electrical and Electronics Engineering**							
	20OE203	Energy Conversion Systems	OEC-2	3	0	0	40	60	3
	20OE204	Smart grid	OEC-2	3	0	0	40	60	3
		Courses offered by: **Mechanical Engineering**							
	20OE306	Automotive Electronics, Sensors & Drives	OEC-2	3	0	0	40	60	3
	20OE307	Robotics and Applications in Manufacturing	OEC-2	3	0	0	40	60	3

	20OE308	Sensors in Intelligent Manufacturing	OEC-2	3	0	0	40	60	3
	20OE309	Non-Conventional Sources of Energy	OEC-2	3	0	0	40	60	3
	20OE310	Supply Chain Management	OEC-2	3	0	0	40	60	3
	Courses offered by: **Electronics and Communication Engineering**								
	20OE403	Introduction to VLSI	OEC-2	3	0	0	40	60	3
	20OE404	Principles of Communication	OEC-2	3	0	0	40	60	3
	Courses offered by: **Artificial Intelligence and Machine Learning**								
	20OE3903	Operating Systems	OEC	3	0	0	40	60	03
	20OE3904	Data Base Management Systems	OEC	3	0	0	40	60	03
	Courses offered by: **Humanities and Sciences**								
	20OE603	Mathematical Statistics for Data Science and Data Analytics	OEC	3	0	0	40	60	03
	20OE608	Basics of Electrical, Magnetic and Optoelectronic materials	OEC	3	0	0	40	60	03
	20OE609	Corrosion & Control	OEC	3	0	0	40	60	03
	20OE615	Academic Writing	OEC	3	0	0	40	60	03
	20OE611	Basics Financial Management for Engineers	OEC	3	0	0	40	60	03
6	2039607	Software Engineering Lab	PCC LAB	0	0	3	40	60	1.5
7	2039608	Predictive Analytics Modeler Lab (IBM)	PCC LAB	0	0	3	40	60	1.5
8	2039609	Deep Learning Lab	PCC LAB	0	0	3	40	60	1.5
9	2024654	**Skill Course – IV:** Soft Skills Lab	SC	1	0	2	40	60	02
		Total					**360**	**540**	**21.5**

VII Semester

S.No	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
1	2039701 2039702 2039703	**Professional Elective Course – III:** **1.** Artificial Intelligence Analyst (IBM) **2.** Virtual and Augmented Reality	PEC	3	0	0	40	60	03

		3. Natural Language Processing							
2	2039704 2039705 2039706	**Professional Elective Course – IV:** **1.** Robotics and Automation **2.** Reinforcement Learning **3.** Blockchain Technology	PEC	3	0	0	40	60	03
3	2039707 2039708 2039709	**Professional Elective Course – V:** **1.** Internet of Things **2.** Cognitive Science **3.** Digital Forensic	PEC	3	0	0	40	60	03

4	**Open Elective-3**								
	Courses offered by: **Civil Engineering**								
	20CE107	Repair and rehabilitation of structures	OEC-3	3	0	0	40	60	3
	20CE108	Geo-environmental engineering	OEC-3	3	0	0	40	60	3
	20CE109	Environmental impact assessment	OEC-3	3	0	0	40	60	3
	Courses offered by: **Mechanical Engineering**								
	20OE311	Entrepreneurship	OEC-3	3	0	0	40	60	3
	20OE312	Solar Energy Systems	OEC-3	3	0	0	40	60	3
	20OE313	Internal Combustion Engine	OEC-3	3	0	0	40	60	3
	Courses offered by: **Electrical and Electronics Engineering**								
	20OE205	Intelligent Control Techniques	OEC-3	3	0	0	40	60	3
	20OE206	Electrical System Estimation & Costing	OEC-3	3	0	0	40	60	3
	Courses offered by: **Electronics and Communication Engineering**								
	20OE405	Electronic Instrumentation and measurements	OEC-3	3	0	0	40	60	3
	20OE406	Introduction to IOT	OEC-3	3	0	0	40	60	3
	20OE407	Nano Electronics	OEC-3	3	0	0	40	60	3
	Courses offered by: **Artificial Intelligence and Machine Learning**								
	20OE3905	Cyber Security	OEC-3	3	0	0	40	60	03
	20OE3906	Java Programming	OEC-3	3	0	0	40	60	03

	Courses offered by: **Humanities and Sciences**								
	20OE612	Transforms and Its Applications	OEC-3	3	0	0	40	60	3
	20OE613	Physics of Renewable Energy	OEC-3	3	0	0	40	60	3
	20OE614	Fuel Technology	OEC-3	3	0	0	40	60	3
	20OE615	Professional Communication	OEC-3	3	0	0	40	60	3
	20OE616	Digital and Social Media Management	OEC-3	3	0	0	40	60	3
5	**Open Elective -4**								
	Courses offered by: **Civil Engineering**								
	20OE110	Industrial safety engineering	OEC-4	3	0	0	40	60	3
	20OE111	Surveying	OEC-4	3	0	0	40	60	3
	20OE112	Traffic Engineering	OEC-4	3	0	0	40	60	3
	Courses offered by: **Mechanical Engineering**								
	20OE314	Energy Auditing	OEC-4	3	0	0	40	60	3
	20OE315	Sustainable Engineering	OEC-4	3	0	0	40	60	3
	20OE316	Industrial Engineering & Management	OEC-4	3	0	0	40	60	3
	Courses offered by: **Electrical and Electronics Engineering**								
	20OE207	Basic Power Electronics	OEC-4	3	0	0	40	60	3
	20OE208	System Reliability Concepts	OEC-4	3	0	0	40	60	3
	Courses offered by: **Electronics and Communication Engineering**								
	20OE408	Fundamentals of RADAR Engineering.	OEC-4	3	0	0	40	60	3
	20OE409	Biomedical Instrumentation	OEC-4	3	0	0	40	60	3
	20OE410	Digital Circuits	OEC-4	3	0	0	40	60	3
	Courses offered by: **Artificial Intelligence and Machine Learning**								
	20OE3907	Data Analytics with Python	OEC-4	3	0	0	40	60	3
	20OE3908	Web Designing using PHP	OEC-4	3	0	0	40	60	3

	Courses offered by: **Humanities and Sciences**								
	20OE617	Operations Research	OEC-4	3	0	0	40	60	3
	20OE618	Fundamentals of Quantum Computation and Nano photonics	OEC-4	3	0	0	40	60	3
	20OE619	Green Chemistry & Technology	OEC-4	3	0	0	40	60	3
	20OE620	Creative Writing	OEC-4	3	0	0	40	60	3
	20OE621	Materials Management	OEC-4	3	0	0	40	60	3
6	2006701 2006702 2006703	**Humanities & Social Sciences Elective:** **1.** Human Resource Management **2.** Digital Marketing **3.** Project Management	HSS	3	0	0	40	60	03
7	2039711	Internship	PROJ	0	0	0	100	---	03
8	2039712	**Skill Course – V:** Multimedia and Application Lab	SC	1	0	2	40	60	02
		Total					**380**	**420**	**23**

VIII Semester

S.No	**Subject Code**	**SUBJECT**	**SC**	**L**	**T**	**P**	**IM**	**EM**	**CR**
1	2039801	Project Work / Internship in Industry (6 months)	PROJ	0	0	0	40	60	12
		Total					**40**	**60**	**12**

B.Tech I SEM AI&ML (R20)

Course Title	Linear Algebra & Calculus					B.Tech AI&ML I Sem (R20)		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2021101	BS	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 90 Minutes					End Exam Duration: 3Hrs			

Course Objectives:

- This course will illuminate the students in the concepts of calculus and linear algebra.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	Develop the use of matrix algebra techniques that is needed by engineers forpractical applications
CO 2	Utilize mean value theorems to real life problems
CO 3	Classify the functions of several variables which are useful in optimization techniques.
CO 4	Evaluate multiple integrals.
CO 5	Define Beta and Gamma functions.

UNIT -I

Rank of a matrix by Echelon form, Normal form. Solving system of homogeneous and non- homogeneous linear equations. Eigen values and Eigen vectors for real matrices – Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley–Hamilton theorem. Diagonalisation by orthogonal transformation.

UNIT -II

Mean Value Theorems: (08 Hours)

Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Taylor's and Maclaurin's theorems with remainders (without proof), related problems.

UNIT -III

Multivariable Calculus: (10 Hours)

Partial derivatives, total derivative, chain rule, change of variables, Jacobians, Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT -IV

Multiple Integrals: **(10 Hours)**

Evaluation of double integrals in Cartesian coordinates and polar coordinates – Change of variables in double integrals – Change the order of integration in double integrals – Evaluation of triple integrals in Cartesian and polar coordinates – Change of variables between Cartesian, cylindrical and spherical polar coordinates.

UNIT -V

Beta and Gamma functions: **(08 Hours)**

Beta and Gamma functions and their properties, relation between Beta and Gamma functions, evaluation of definite integrals using Beta and Gamma functions.

Text Books:

1. Higher Engineering Mathematics, Dr. B.S. Grewal, Khanna Publishers-44 edition.
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Publications, 10^{th} edition- 2021.

Reference Books:

1. Higher Engineering Mathematics, B.V. Ramana, Mc. Graw Hill Education (India)Pvt. Ltd, New Delhi, 11^{th} Edition, Reprint 2010.
2. Linear Algebra: A Modern Introduction, D Poole, 2^{nd} Edition, Brooks/Cole, 2005. A Text Book of Engineering Mathematics, N.P. Bali and Manish Goyal, Lakshmi Publications, Reprint 2008.

Course Title	Environmental Chemistry					B.Tech AI&ML I Sem (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2023103	**BS**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 90 Minutes						**End Exam Duration: 3Hrs**		

Course Objectives:

- To provide the fundamental knowledge concerning the chemical-physical characteristics of air, water and soil.
- Able to understand the main environmental pollutants present & control measures

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the interconnections between different sectors of the environment like soil, water and atmosphere.
CO 2	Explain basic chemical composition of water & factors that influence the quality ofwater
CO 3	Describe waste water treatment processes and the practical approach for testingwater quality involved.
CO 4	Analyze the different types of pollutions such as Soil & Radioactive pollution which influence the environment
CO 5	Better realization about the causes of Industrial pollution &sustainable development by applying Green Chemistry.

UNIT-I

Introduction to Environment & Atmosphere Chemistry:

Introduction to environment, Atmosphere, environmental segments, Components of environment, earth's radiation balance, particulates, ions, radicals and their formation. Air pollution: Introduction, Sources-oxides of C, N, S, their effects& control measures. Climatic changes- acidrain, Photo chemical smog formation, Green-house effect, global warming and ozone depletion

UNIT-II

Hydrosphere:

Water; Sources of water & its distribution in environment, Chemical composition of water bodies- lakes, streams, rivers, sea, estuaries etc., hydrological cycle. Water pollution-inorganic, organic pesticides, industrial and radioactive materials, oil spills and oil pollutants, eutrophication, Biomagnification, Water borne diseases.

UNIT-III

Water Quality parameters and its Analysis:

Various water quality parameters- drinking & industrial water. Experimental methods for measuring Hardness of water by EDTA method, DO by Winkler's method, Chlorides, Alkalinity, & TDS. Waste water treatment; domestic waste water-aerobic and anaerobic treatment, and industrial waste water treatment- Open Pond system.

UNIT-IV

Soil Pollution

Soil pollution - agricultural pollution - use of chemical fertilizers - Organic chemicals and environment-Agrochemicals-Pesticides, insecticides and herbicides, effects of various pesticides in agriculture on excessive use.

UNIT-V

Environmental Pollution and Control

Effects of Air pollution, Water pollution, Soil pollution&Radioactivepollutionand their control measures. Solid waste disposal - methods - solid waste from mining and metal production and its disposal - electro-coagulation and flocculation.

Text books:

1. Perspectives in Environmental Studies – AnubhaKaushik, C. P. Kaushik, New Age International Publishers.
2. Fundamental Concepts of Environmental Chemistry- Sodhi G S – Oxford University
3. Environmental Chemistry- Anil Kumar De-Willey Publications

Reference Books:

1. Textbook of Environmental Sciences by A.K. Agrawal -Student Editions
2. Air pollution-M.N. Rao, HVN Rao- McGraw Hill publications
3. Environment Impact Assessment- Larry W. Canter- McGraw Hill publications

<table>
<tr><td>Course Title</td><td colspan="4">Problem Solving With Algorithmic Thinking</td><td colspan="3">B.Tech AI&ML I Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039103</td><td rowspan="2">ES</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>2</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 90 Minutes</td><td colspan="3">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
• To provide the foundations of Computational Problem Solving.
• It aims to train the student to the basic concepts of the C programming language</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Apply algorithmic thinking to understand, define and solve problems</td></tr>
<tr><td>CO 2</td><td colspan="8">Apply the basic programming constructs for problem solving.</td></tr>
<tr><td>CO 3</td><td colspan="8">Implement different Operations on arrays, Pointers.</td></tr>
<tr><td>CO 4</td><td colspan="8">Use functions to solve the given problem.</td></tr>
<tr><td>CO 5</td><td colspan="8">Understand structures and unions.</td></tr>
</table>

UNIT-I

Introduction to Computers: - Introduction, computer hardware and software.

Problem Solving and Algorithmic Thinking Overview – problem definition, logical reasoning; Algorithm –definition, practical examples, properties,representation, algorithms ,Flow chart-Definition ,Practical Examples, creating andrunning programs, software development life cycle.

UNIT-II

Introduction to C programming: - Overview of C, structure of a C program, variables, constants, data types, identifiers, keywords, Input/output statements in C, programming examples.

Operators and Expressions: - Operators, expressions, precedence and associativity, evaluating expressions, type conversion, type def, enumerations. **Decision making statements**: if statement, if-else statement, nested if-else statement, switch statement.

UNIT-III

Loops in C: while loop, for loop, do-while loop, nested for loops, **Jumpingstatements**: break, continue and goto statements.

Arrays: Introduction, Declaration and initialization of 1D and 2D arrays. **Strings**: - Definition, declaration and initialization of strings, string I/O functions, string handling functions, array of strings (table of strings).

Pointers: Idea of pointers, Defining pointers, Pointers to Arrays and Structures, Use of Pointers in self referential structures, usage of self referential structures in linked list.

UNIT -IV

Functions: Designing structured programs, Declaring a function, Types of functions, Parameters and return type of a function, passing parameters to functions, call by value, Call by Reference, Passing arrays to functions.

Recursion Problem Solving Techniques: Factoring and Recursion Techniques, Dynamic memory allocation: Allocating and freeing memory.

UNIT –V

Structures and union: Introduction, defining a structure, declaring structure variable, structure initialization, accessing members of structure, copying andcomparing structure variables, structures within structures, array of structures, and introduction of union.

Text Books:

1. Riley DD, Hunt KA. Computational Thinking for the Modern Problem Solver.CRC press; 2014 Mar 27.

2. E. Balagurusamy, Programming in ANSI C, Fifth Edition, McGraw Hill.

3. Rema Theraja, Programming in C, second edition, Oxford.

Reference books:

1. R. G. Dromey, “How to solve it by Computer”, PHI, 2008 2.YashavantKanetkar,

Let us C, 15th edition, BPBPublications.

3 .Dr.P.ChennaReddy, Computer Fundamentals and C Programming, SecondEdition.

<table>
<tr><td>Course Title</td><td colspan="4">Professional Communication</td><td colspan="3">B.Tech AI&ML I Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2024104</td><td rowspan="2">HS</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>2</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- Enhance language skills and vocabulary for professional success.
- Help the students thorough with presentation skills to become effective participantsin various discussions.
- Develop confidence and become effective communicator.
- Make them write and speak grammatically correct sentences.
- Analyze interview techniques to get success at interviews.

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	Develop language skills and vocabulary for professional success
CO 2	Make the students thorough with presentation skills and become successful
CO 3	Enhance confidence and become effective communicator
CO 4	Speak and write grammatically correct sentences
CO 5	Analyze interview techniques and get success at interviews

UNIT -I

Importance of communication - Role of language in communication - Technicalvocabulary - Verbal analogies - Synonyms and Antonyms.

Grammar: Parts of speech - Discussion and Identification - Question tags.

UNIT-II

Reading Comprehension - Guidelines for effective understanding of the given text -Passage for comprehension - SQ3R method - PQRST method.

Grammar: Subject - Verb agreement - Embedded sentences - Conditional clauses.

UNIT-III

Oral Presentation - Preparation - Guidelines for effective presentation - Kinesics **Grammar:** Transformation - Affirmative and Negative -Active and Passive - Direct andIndirect - Degrees of Comparison - Simple, Compound and Complex.

UNIT-IV

Group Discussion - Introduction - Dos and Don’ts - strategies of GD.

Grammar: Dialogue writing - Proverbial expansion –

UNIT-V

Interview skills - Preparation - Before, During and After the interview - Dos and Don'tsof interview - FAQs at interviews - Resume building.

Grammar: Common errors in everyday use and their correction.

Reference Books:

1. English for Engineers and Technologists (Combined edition, Vol. 1 and 2), OrientBlack swan 2010.

2. Meenakshi Raman and SangeethaSharma,"Technical Communication: Principles and Practice", 2nd Edition, Oxford University Press, 2011

3. AnandGanguly, "Success in Interview", RPH, 5th Edition, 2016

4. English Grammar and Composition : Wren & Martin, S. Chand and Company Ltd, New Edition 2020

5. English Grammar and In Use: Reymond Murphy, Cambridge University Press - 5th Edition.

6. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015

<table>
<tr><td>Course Title</td><td colspan="5">Python Programming</td><td colspan="3">B.Tech AI&ML I Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039105</td><td rowspan="2">ES</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- Explain variables, strings and functions
- Use of mathematical operators and functions
- Explain different statements like if, for etc. Explain the python libraries
- Explain Details of the Pandas library o Series and Data Frames
- Define regression with Use case study, Define exploratory data analysis
- Define churn analysis with Use case, Define advance Machine learning Algorithms

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Installing and get start with python and using basic variables and stings in python
CO 2	How to input data in Python, Use Boolean with python, Using If and LoopingStatements in Python
CO 3	Installing Pandas, Work with series and data frames.
CO 4	Work with regular expression**,** Work with Pattern matching**,** Parse data
CO 5	Apply advanced Machine learning algorithms**,** Work on Support vector machines, Define Random forest

UNIT-I

Introduction to PYTHON

What is Python, its advantages and disadvantages, how to run python scripts, how touse variables, string operator and functions.

UNIT - II

Deep dive into PYTHON

Working of Python like inputting the data, working with Boolean and other statements

UNIT- III

Python Libraries

The use of pandas library for data analysis

Error Handling

Dealing with different type of errors that one can encounter while working with Python.

Other Topics

How to deal with miscellaneous things in python.

UNIT- IV

Regression (Use case study)

Regression analysis with the help of a use case.

Other Regression related topics

Topics which are important from the point of view of data analytics

UNIT –V

Advance

Some advance data analytics techniques.

Text Books:

1. Numerical Python : A Practical Techniques Approach for Industry By RobertJohansson published by Apress.
2. Pandas for Everyone: Python Data Analysis, First EditionBy Daniel Y. Chen **PUBLISHEDBY:** Addison-Wesley Professional.
3. Become a Python Data Analyst by Alvaro Fuentes by Packt publishing

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<table>
<tr><td>Course Title</td><td colspan="5">Introduction to Digital Manufacturing</td><td colspan="3">B.Tech AI&ML I Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2013106</td><td rowspan="2">ES</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>2</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
To study the Role of computer in Digital manufacturing
To Study concepts of Additive Manufacturing
To study the Concepts of powder based Digital Manufacturing
To study the Vat Photo Polymerization Methods
To study various Errors in steel Files and software for RP</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">At End of semester student gains knowledge Importance of computers in Digital manufacturing.</td></tr>
<tr><td>CO 2</td><td colspan="8">Student Gains Knowledge in Basic concepts of Additive Manufacturing.</td></tr>
<tr><td>CO 3</td><td colspan="8">Students Gains Knowledge in various powered based Digital Manufacturingsystems.</td></tr>
<tr><td>CO 4</td><td colspan="8">At the end of semester student gains knowledge in Lom process and conceptmodelers.</td></tr>
<tr><td>CO 5</td><td colspan="8">Student gain knowledge in direct and indirect tooling and part buildingerrors, software for Rp</td></tr>
</table>

UNIT-I

Role of computers in Industrial Manufacturing. CAD/CAM/CAE technologies and product lifecycle management (PLM). Expression of product design ideas using 2D sketches. Applications of CAD/CAM.

UNIT-II

Introduction to Additive manufacturing, Basic procedure of additive manufacturing, categories of additive manufacturing /applications of Additive manufacturing, comparison of additive manufacturing and subtractive manufacturing, Hybrid manufacturing, Challenges and limitations of current additive manufacturing, Additive manufacturing Techniques

UNIT-III

Introduction to powder bed fusion of polymers: Introduction, Processes ,Machines and Technologies, post processing and surface treatment, Advantages and Disadvantages and Applications, Selective laser sintering concept, Applications.

UNIT-IV

VAT Photo Polymerization Methods in Additive Manufacturing: Introduction ,VAT Polymerization Process, Advantages ,Disadvantages and Applications, Fusion Deposition modeling, Solid ground curing, process and Applications.

UNIT-V

Software for RP**:** STL files, Overview of Solid view, magics, imics, magic communication, etc. Internet based software, Collaboration tools. Rapid Manufacturing Process Optimization**:** Factors influencing accuracy, Data preparation error, Part building error, Error in finishing, Influence of build orientation. Concepts of cura.

Text Books:

1. Additive manufacturing,juanpou,Antoniriveiro,J.PauloDavim,Elesevier
2. "Stereo lithographyand otherRP &MTechnologies**"**, Paul F.Jacobs, SME, NY1996
3. "Rapid Manufacturing**",**Flham D.T&DinjoyS.S,VerlogLondon 2001
4. CAD/CAM P.N RAO,Tata MC Graw Hill,2015

Reference Books:

1. Additive Manufacturing Technologies by LanGibson, DavidRosen, springer
2. Introduction to Additive manufacturing, Dr.Sridhars Natesh CPInsc International Publishers.
3. Additive Manufacturing C.P.Paul, A.N Jinoop, MCGraw Hill 2021.

Course Title	Agriculture for Engineers & Field Activity Lab				B.Tech AI&ML I Sem (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20AG107	**BS**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		0	**0**	**3**	**1.5**	**40**	**60**	**100**
					End Exam Duration: 3Hrs			

Course Objectives:

- To provide the fundamental knowledge concerning the agriculture related materials

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Identify various types of soils and their mineral content
CO 2	Estimate the amount of Dissolved oxygen and PH in water sample
CO 3	Understand the Traditional & Conventional methods used in farming
CO 4	Analyze the use of drip irrigation method in farming
CO 5	Apply the analyzed skills of students in preparation of farming lands & harvestingcrops

List of experiments for Agriculture Engineering

1. Identification of Various soil types
2. Soil testing – moisture, Mineral testing
3. Water sample testing PH
4. BOD
5. COD
6. Identifying various weeds and other insects that harm the agriculture.
7. Preparation of farm land
8. Sowing of seeds and water supply
9. Observation of plant growth and removal of weeds
10. Visit of nearby farms and KrishiVigyan Kendra understating the traditional and conventional methods
11. Using of sprinklers / drip irrigation
12. Harvesting of the crop

Reference Books:

1. Laboratory Manual Engg. Chemistry, Anupma Rajput, DhanpatRai& Co.
2. Vogel's Text book of Quantitative Chemical Analysis, J. Mendham et.al., Pearson Education, Sixth Edition, 2012.
3. *Farm Mechanics Text and Handbook* (Danville, IL: The Interstate, 1946), by Glen Charles Cook, L. L. Scranton, and H. F. McColly (page images at HathiTrust)
4. *Agricultural Process Engineering* (first edition; New York: J. Wiley and Sons; London: Chapman and Hall, 1955), by S. M. Henderson and R. L. Perry (page images at HathiTrust)
5. *Farm Shop Work, Practical Manual Training* (New York et al: American Book Company, c1915), by Gerald Brace and D. D. Mayne, contrib. by Charles A.Prosser (multiple formats at archive.org)

<table>
<tr><td>Course Title</td><td colspan="5">Problem Solving Using C Lab</td><td colspan="3">B.Tech AI&ML I Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039108</td><td rowspan="2">ES</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5"></td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
• To make the student learn C Programming language.
• To make the students solve problems, implement them using C language</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Able to write, compile and debug programs in C language and use different data types in a computer program.</td></tr>
<tr><td>CO 2</td><td colspan="8">Able to implement programs involving decision structures, loops, arraysand functions on different applications.</td></tr>
<tr><td>CO 3</td><td colspan="8">Able to implement the modular programming concepts, pointers, structures and unions.</td></tr>
<tr><td>CO 4</td><td colspan="8">Able to develop the concepts of file I/O operations and random access to files.</td></tr>
</table>

LIST OF EXPERIMENTS:

1. Practice DOS/LINUX commands necessary for design of C programs.

2. Write, edit, debug, compile and execute sample C programs to understandthe programming environment.

3. a) Write a C program to find the sum of the individual digits of a given number.

   b) Write a C program to c heck whether a given number is a palindrome ornot.

4. a) Write a C program to generate& print first n terms of the Fibonacci sequence.

   b) Write a C program to find the roots of a quadratic equation.

5. a) Write a C program to computer the factorial of a given number.

   b) Write a C program to generate all the prime numbers within a given range.

6. a) Write a C program to generate PASCAL triangle.

   b) Write a C program to find the GCD of two integers.

7. a) Write a C program to e valuate the function Sin(x) as defined by the infiniteseries expression.

$$\mathrm{Sin}(x) = \frac{x}{1!} - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \cdots$$

   b) Write a C program to find the square root of a given number.

8. a) Write a C program to find both smallest and largest number in a list of integers.

   b) Write a C program to perform multiplication of two matrices.

9. Write a C program to read a matrix and perform the following operations.

   i) Print transpose of a matrix.
   ii) Removal of duplicates from an ordered array.

10. a) Write a C program to perform arithmetic operations using functions.

    b) Write a C program to find the factorial of a given number using recursive function.

11. a) Write a C program to count the number of vowels, constants, blankspaces, digits and special characters in a given string.

    b) Write a C program to c heck whether a given string is palindrome or not.

12. Write a C program to read two strings and perform the following operationswithout using built-in string library functions.

    i) String length determination.
    ii) Comparison of two strings.
    iii) Concentration of two strings.
    iv) String reversing.

13. Write a C program to define a structure with the following members.

    Roll No., Name, marks in Sub1, Sub2, Sub3. Read the n students records andfind the total marks of each student and print the result in the following format.

Roll No.	Name	Sub1	Sub2	Sub3	Total Marks	Result
1234	XXX	40	50	90	180	Distinction

<table>
<tr><td>Course Title</td><td colspan="4">Python Programming Lab</td><td colspan="3">B.Tech AI&ML I Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039109</td><td rowspan="2">ES</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5"></td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- To write, test, and debug simple Python programs.
- Know when and how to use the appropriate statements available in the python.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python.

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	Understand and solve the basics of python programming
CO 2	Learn and implement iterative as well as recursive programs in python
CO 3	Represent heterogeneous data with right sequence in python
CO 4	Develop Programs using object-oriented features in python

List of Sample Experiments:

1. Calculate the following programs using Python
   i. Area of Circle
   ii. Simple and Compound Interest
   iii. Celsius to Fahrenheit
   iv. Volume of Sphere

2. Write a Python program to find distance between two points (X1, Y1)and (X2, Y2).

3. Implement the following programs using Python
   i. To find given number is Even or Odd number
   ii. Find Maximum of Two numbers
   iii. Find given number is Zero, Positive or Negative
   iv. Find Minimum of Two numbers
   v. Find given year is leap year or not

4. Write a Python program to find Roots of Quadratic equation.

5. Write a Python program to read credits and grades of five differentsubjects and display SGPA based on the following table.

Class	SGP A
Distinction	>=7.5
First Class	>=6.5 <7.5
Second Class	>=5.5 <6.5
Pass	>=4.5 <5.5
Fail	<4.5

$$SGPA= \frac{\Sigma(Ci*Gi)}{\Sigma\, Ci}$$

6. Write a Python program to design arithmetic calculator based on userchoice like
   1. Addition 2. Subtraction 3. Multiplication 4. Division.

7. Implement the following programs using Python
   i. Sum of Digits of a given number
   ii. Given number is Palindrome or not
   iii. Find given number is Armstrong number or not
   iv. Factorial of a given number

8. Write a Python program to display sum of even valued terms and oddvalued terms individually by considering terms of Fibonacci series upto n.

9. Using with and without Python objects on console.

10. Using mathematical functions on console.

11. Write an Python script, to create Python objects for calculator application and save in a specified location in disk.
12. Write an Python script to find basic descriptive statistics using summary.

13. Write an Python script to find subset of dataset by using subset ()

14. Reading different types of data sets (.txt, .csv) from web and disk andwriting in file in specific disk location.
15. Reading Excel data sheet in Python.

16. Reading XML dataset in Python

17. Find the data distributions using box and scatter plot.

<table>
<tr><td>Course Title</td><td colspan="4">Indian Traditional Knowledge</td><td colspan="3">B.Tech AI&ML I Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20MC110</td><td rowspan="2">MC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>--</td><td>40</td><td>--</td><td>40</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4"></td></tr>
</table>

Course Objectives:

- To facilitate the students with the concepts of Indian traditional knowledge and tomake them understand the importance of roots knowledge system.
- To make the students understand the traditional knowledge and analyses it and apply it to their day to day life.

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	To understand the Indian culture and Ancient practices.
CO 2	To acquire knowledge on Indigenous practices.
CO 3	To illustrate the various trend changes in society.
CO 4	To develop sustainable practices for future.
CO 5	To impart knowledge and strive towards SDGs.

UNIT-I

Overview of the Indian tradition, culture, and knowledge:

Introduction, Indian Culture, Ancient Practices, Knowledge - Scripts and sculptures.

UNIT-II

Indigenous Knowledge:

Natural Resources in India, Self -Sustaining societies, Emergence of science throughtradition, Indigenous knowledge.

UNIT-III

Changing Trends:

Cultural practices, Resource Utilization, Technological Advancement, Resource exploitation & Conflicts, Current scenario – Indigenous knowledge & practices, Climate Change & Ecological crisis.

UNIT-IV

Sustainable Solutions for Sustainable Society:

Biodiversity Conservation, Emergence of Renewable Energies, Waste ManagementSystems, Sustainable Livelihood Practices.

UNIT-V

Global trends for sustainable development

Case studies, Global Institutions, Indian SDGs & Action Plans

Text Books:

1. Gunde Padma and A. Uma Shankar Kumar, Indian Traditional Knowledge,Virndiya Publications, First Edition-2021.

Reference Books:

1. Traditional Knowledge System in India, by AmitJha, 2009.
2. Traditional Knowledge System in India by AmitJha Atlantic publishers, 2002.
3. "Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2.

Web Links:

1. https://www.youtube.com/watch?v=LZP1StpYEPM
2. http://nptel.ac.in/courses/121106003/

B.Tech II SEM AI&ML (R20)

Course Title	Biology for Engineers					B.Tech AI&ML II Sem (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2023201	**BS**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		2	**0**	**0**	**2**	**40**	**60**	**100**
Mid Exam Duration: 90 Minutes					**End Exam Duration: 3Hrs**			

Course Objectives:

- Introduction to Basics of Biology which includes cell, the unit of life, Different typesof cells and classification of living organisms.
- Understanding what are biomolecules present in a cell, their structure function andtheir role in a living organism. Application of certain bio molecules in Industry.
- Brief introduction to human physiology, which is essential for bioengineering field.
- Understanding the hereditary units, that is genes and genetic materials (DNA and RNA) present in living organisms and how they replicate and pass and preserve vital information in living organisms.
- How biology can be applied in our daily life using different technology, for production of medicines to transgenic plants and animals to designing new biotechnological products

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	Define the cells, its structure and function, and Different types of cells and basisfor Classification of living organisms.
CO 2	Explain about biomolecules its structure and function and their role in a livingorganism. How biomolecules are useful in Industry & explain about human physiology.
CO 3	Demonstrate the concept of biology and its uses in combination with different technologies for production of medicines and production of transgenic plants andanimals.
CO 4	Illustrate about genes and genetic materials (DNA & RNA) present in living organisms and how they replicate, transfer & preserve vital information in living organisms.

UNIT-I

Introduction to Basic Biology Cell:

Cell theory, Cell shapes, structure of a Cell, The Plant Cell and animal Cell ,Cell cycle, types of chromosomes, prokaryotic and eukaryotic Cell, Plant Tissue and Animal Tissue.Brief introduction to classification of Kingdoms- kingdom classification by Linnaeus.

UNIT-II

Introduction to Bio-molecules

Classification of Biomolecules-Introduction, Classification of carbohydrates- Monosaccharide's, Disaccharides, Oligosaccharides- Sources & their uses, Proteins- Amino acid-Classification based on Structure, Sources & their uses, Lipids-Definition , sources & their uses. Nucleic acid -DNA and RNA-Structure &their types.Large scale production of enzymes by Fermentation.

UNIT-III

Human Physiology

Nutrition -Classes of nutrients or food substances-Micronutrients & Macronutrients- Sources, uses & their deficiency disorders, Digestive systems-Structure & its mechanism, Respiratory system (two kinds of respiration – aerobic and anaerobic), Respiratory organs-Structure & functions, Excretory system-Structure & functions.

UNIT-IV

Genes, Replication of DNA, And Introduction to recombinant DNA Technology:

Prokaryotic gene and Eukaryotic gene structure, DNA replication, Gene expression- Transcription and Translation in Prokaryote and Eukaryote .Recombinant DNA technology (Insulin production), Mutation-definition, uses & its applications.

UNIT-V

Application of Biology

Genetic Engineering-production of vaccines, its components, types of vaccines, Enzymes and their application in industry, type of antibodies, transgenic plants (BT cotton) and animal (Dolly), Biosensors-characteristic, basic principles ,biological applications. Tissue-engineering-objective/goals, components, applications. Bio engineering- introduction to bio engineering & its applications, Bio fuels –Types and uses.

Text Books:

1. Cell and Molecular Biology-P.K.Gupta
2. Cell Biology-Verma and Agarwal
3. Cell Biology-Rastogi
4. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, “Biology: A global approach”, Pearson Education Ltd, 2018.
5. T Johnson, Biology for Engineers, CRC press, 2011 Molecular Biology and Biotechnology 2nd ed. J.M. Walker and E.B. Gingold. Panima Publications.PP 434.
6. Biotechnology U. SatyaNarayanaPublisher: Books & Allied LtdGenre: ENGINEERING ISBN: 9780125002615, 0125002610
7. Industrial Biotechnology ,ShastriVarun Publisher: Gyan Books Genre: ScienceISBN: 9788182053762, 9788182053762.

Reference Books:

1. AlbertsEt.Al. The molecular biology of the cell, 6/e, Garland Science, 2014
2. De Robertis EDP & EMF De Robertis. 2001. Cell and Molecular biology. Lippincott Williams &Wilkins.Bombay.
3. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, “Outlines of Biochemistry”, John Wiley and Sons, 2009.
4. John Enderle and Joseph Bronzino Introduction to Biomedical Engineering, 3/e, 2012 Principles of Biochemistry.2nd ed. 1993. A.L. Lehninger, D.L.Nelson.M.Cox. Paniama Publications.PP. 1090.
5. Harper’s biochemistry. 1988. R.K. Murray. D.K. Granner, P.A. Mayes. Printice Hall International.
6. Introductory Microbiology. 1995, by Trevor Gross.
7. Molecular Biology by G. Padmanabhan, K. SivaramSastry, C. Subramanyam, 1995, MacMillan.
8. Biochemistry of Nucleic Acids. 1992. 11thed.R.L.P.Adams .J.T.Knowler.D.PLeader. Chapman and Hall.
9. Genetic Engineering –SandhyaMitra.
10. Molecular Biology and Biotechnology by Meyers, RA, A comprehensive Desk reference (VCH Publishers).

<table>
<tr><td>Course Title</td><td colspan="4">Applied Physics</td><td colspan="4">B.Tech AI&ML II Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20AP202</td><td rowspan="2">BS</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>2</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- To identify the importance of the optical phenomenon i.e. interference, diffraction and polarization related to its Engineering applications
- To understand the mechanisms of emission of light, the use of lasers as light sources for low and high energy applications, study of propagation of light wave through optical fibres along with engineering applications.
- To explain the significant concepts of dielectric and magnetic materials that leads to potential applications in the emerging microdevices.
- To enlighten the concepts of Quantum Mechanics and to provide fundamentals of de'Broglie waves, quantum mechanical wave equation and its applications, the importance of free electron theory and band theory of solids.
- Evolution of band theory to distinguish materials, basic concepts and transportphenomenon of charge carriers in semiconductors. To give an impetus on the subtle mechanism of superconductors using the concept of BCS theory and their fascinating applications.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Study the different realms of physics and their applications in both scientific technological systems through physical optics.
CO 2	Identify the wave properties of light and the interaction of energy with the matter. Asses the electromagnetic wave propagation and its power in different media.
CO 3	Understands the response of dielectric and magnetic materials to the appliedelectric and magnetic fields.
CO 4	Study the quantum mechanical picture of subatomic world along with the discrepancies between the classical estimates and laboratory observations of electron transportation phenomena by free electron theory and band theory.
CO 5	Elaborate the physical properties exhibited by materials through the understanding of properties of semiconductors and superconductors.

UNIT-I

Wave Optics

Interference- Principle of superposition – Interference of light – Conditions for sustained interference - Interference in thin films (Reflection Geometry) – Colors in thin films – Newton's Rings – Determination of wavelength and refractive index.

Diffraction- Introduction – Fresnel and Fraunhofer diffraction – Fraunhofer diffraction due to single slit, double slit and N-slits (qualitative) – Grating spectrum.

UNIT-II

Lasers and Fiber optics

Lasers-Introduction – Characteristics of laser – Spontaneous and Stimulated emission of radiation – Einstein's coefficients – Population inversion – Lasing action – Pumping mechanisms – Nd-YAG laser – He-Ne laser – Semiconductor diode laser- Applications of lasers.

Fiber optics-Introduction – Principle of optical fiber – Acceptance Angle – Numerical Aperture – Classification of optical fibers based on refractive index profile and modes – Block diagram of Optical fiber Communication system - Propagation Losses (qualitative)
– Applications.

UNIT-III

Dielectric and Magnetic Materials

Dielectric Materials-Introduction – Dielectric polarization – Dielectric polarizability, Susceptibility and Dielectric constant – Types of polarizations: Electronic, Ionic and Orientation polarizations (Qualitative) – Lorentz internal field – Clausius-Mossotti equation.

Magnetic Materials-Introduction to magnetic materials (Origin of magnetic moment of an atom and Classification of magnetic materials) –Weiss theory of ferromagnetism- soft ferrites and hard ferrites- Hysteresis – Soft and Hard magnetic materials- Applications magnetic materials.

UNIT-IV

Quantum Mechanics, Free Electron Theory

Quantum Mechanics- Dual nature of matter – Schrodinger's time independent and dependent wave equation – Significance of wave function – Particle in a one- dimensional infinite potential well.

Free Electron Theory-Classical free electron theory (Merits and demerits only) – Quantum free electron theory – Equation for electrical conductivity based on quantum free electron theory – Fermi-Dirac distribution – Density of states – Fermi energy.

UNIT – V

Semiconductors and Superconductors

Semiconductors- Introduction – Intrinsic semiconductors – Electrical conductivity – Fermi level – Extrinsic semiconductors –Dependence of Fermi energy on carrier concentration and temperature – Drift and diffusion currents – Einstein's equation – Direct and indirect band gap semiconductors – Hall effect – Hall coefficient – Applications of Hall effect.

Superconductors- Introduction – Properties of superconductors – Meissner effect – Type I and Type II superconductors – BCS theory – Josephson effects (AC and DC) –High Tc superconductors – Applications of superconductors.

Text Books:

1. Engineering Physics – Dr. M.N. Avadhanulu & Dr. P.G. Kshirsagar, S. Chand andCompany
2. Engineering Physics – B.K. Pandey and S. Chaturvedi, Cengage Learning.

Reference Books:

1. Engineering Physics – Shatendra Sharma, Jyotsna Sharma, Pearson Education,2018
2. Engineering Physics – K. Thyagarajan, McGraw Hill Publishers
3. Engineering Physics - Sanjay D. Jain, D. Sahasrambudhe and Girish, UniversityPress
4. Semiconductor physics and devices- Basic principle – Donald A, Neamen,McGraw Hill.

<table>
<tr><td>Course Title</td><td colspan="4">Introduction to Machine Learning</td><td colspan="3">B.Tech AI&ML II Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039202</td><td rowspan="2">ES</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>--</td><td>40</td><td>--</td><td>40</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4"></td></tr>
</table>

Course Objectives:

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning techniques.
- To build the various of types of machine learning models.
- To evaluate the performance of machine learning algorithms.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the machine learning concepts that are suitable for developing real time applications.
CO 2	Understand the concept of decision tree classifier and develop a model for agiven problem.
CO 3	Apply regression-based learning to solve a real time problem.
CO 4	Understand the concepts of clustering-based machine learning algorithms.
CO 5	Understand outlier analysis and to evaluate the leaning models.

UNIT–I

Introduction: Introduction to Machine Learning, different types of learning, Applicationsof Machine Learning, Data Sets, Splitting the data set into Training and test sets, cross validation. Under fitting, over fitting.

UNIT–II

Machine learning models: Classification, Decision tree classifier ,Naïve Bayesclassifier.

UNIT–III

Regression: Regression, Types of regression, simple linear regression, Logistic Regression.

UNIT–IV

Clustering: Introduction, K-means clustering, K-medoid clustering, Hierarchical clustering.

UNIT– V

Outlier analysis and confusion matrix: outlier and outlier analysis, confusionmatrix, performance and error analysis.

Text Books:

1. Machine Learning, Tom M.Mitchell, McGraw-Hill

Reference Books:

1. Machine Learning: An Algorithmic Perspective, Stephen Marshland, Taylor & Francis
2. Machine Learning: The Art and Science of Algorithms That Make Sense of Data, Peter Flash, Cambridge, University Press.

<table>
<tr><td>Course Title</td><td colspan="5">Data Structures</td><td colspan="3">B.Tech AI&ML II Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039203</td><td rowspan="2">ES</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- To develop skills and analyze linear and nonlinear data structures.
- To understand basic concepts about linked lists, stacks, queues.
- To study algorithms as they apply to trees and graphs.
- To study in detail about sorting, searching and hashing.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the variety of abstract data types and data structures.
CO 2	Analyze data structures such as linked list, Stacks and Queues.
CO 3	Apply and analyze tree traversal algorithms and graph traversal algorithms.
CO 4	Organize data in order using various sorting algorithms.
CO 5	Ability to understand the concept of hashing, B-Trees and B+-Trees.

UNIT-I

Introduction: Data structures, Primitive & Non Primitive data structures, Linear & Non Linear data structures, **Linear Lists:** Definition, **Arrays:** Definition, **Linked Lists:** Single Linked List-Definition, Insertion and Deletion operations**,** Doubly Linked List- Definition, Insertion and Deletion operations.

UNIT-II

Stacks: Definition, Array & Linked representations, Operations, Applications, **Queues:** Definition, Array & Linked representations, Operations, Circular Queues &Dequeues .

UNIT-III

Trees: Basic terminology, Binary Trees- Definition, Properties, Representation, Complete and Full Binary Tree, **Tree Traversal Algorithm:** In order, Preorder and Postorder, **Priority Queues:** Definition, Heaps, Leftist Trees, **Binary Search Tree(BST):** Definition, Operations & Implementations, BST with Duplicates, Indexed BST.

UNIT-IV

Balanced Search Trees: AVL, Red-Black & Splay Trees, Graphs: Terminology, Representations, **Graph Traversal:** Depth First Search (DFS), Breadth First Search (BFS), Minimum Spanning Tree.

UNIT-V

Sorting: Selection, Insertion, Bubble, Heap, **Searching:** Sequential & Binary Search.
Hashing:

Introduction, Hash Table representation, Hash Functions , **Collisions:** Introduction,Separate Chaining, Open Addressing , B-Trees, Operations on B-Trees, B+-Trees.

Text Books:

1. An Introduction to Data Structures with applications, Jean Paul Trembley and Paul G. Sorenson, McGraw Hill.
2. Fundamentals of Data Structures in C, Horowitz, Sahni, Anderson Freed, Universitiespress.
3. Data Structures using C++, VarshaH.Patil, Oxford University Press.

Reference Books:

1. Data Structures, Algorithms and Applications in C++, AnandaRaoAkepogu and RadhikaRajuPalagiri, Pearson Education.
2. Data Structures and Algorithms in C++, S.Sahni, University Press (India) PrivateLimited, Second Edition.
3. Data Structures, Seymour Lipschutz, Schaum's Outlines, McGraw Hill.
4. Data Structures and Algorithms, G.A.V.Pai, Tata McGraw Hill.
5. Data Structures using C and C++, Langsam, Augenstein and Tanenbaum, PHI.
6. Data Structures and algorithms in C++, Mark Allen Weiss, Pearson Education Limited,Second Edition.

Course Title	Mathematics for IntelligentSystem					B.Tech AI&ML I Sem (R20)		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2021204	BS	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		2	0	0	2	40	60	100
Mid Exam Duration: 90 Minutes						End Exam Duration: 3Hours		

Course Objectives:

- This course will illuminate the students in the concepts of application orientation of Mathematics.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Develop the use of matrix techniques that is needed by engineers for practicalapplications.
CO 2	Utilize sequences and series to real life problems.
CO 3	Apply first order differential equations.
CO 4	Evaluate ordinary differential equations of higher order.
CO 5	Apply curvature concepts in engineering problems.

UNIT I

Gaussian Elimination: (08 Hours)

Introduction – Matrix notation and Matrix multiplication - Gaussian elimination – Triangular Factorization methods.

UNIT II

Sequences and series: (08 Hours)

Convergence of sequences and series – Comparison test – p test – D’Alemberts ratio test – Cauchy’s root test (without proofs).

UNIT - III

First order ordinary differential equations: (08 Hours)

Linear, Bernoulli equations. Applications: Orthogonal trajectories, Newton’s law ofcooling, Law of natural growth and decay.

UNIT IV

Ordinary differential equations of higher order: (08 Hours)

Linear differential equations of second and higher order with constant coefficients – R.H.S term of the type e^{ax}, sinax, cosax, polynomials in x, e^{ax} V(x), xV(x).

UNIT V

Differential Calculus: (08 Hours)

Curvature: Curvature of a curve – Curvature of a circle – Radius of a curvature – Centreof Curvature – Equation to the circle of curvature.

Text Books:

1. Higher Engineering Mathematics, Dr. B.S. Grewal, Khanna Publishers-44 edition2017.

2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Publications, 10th edition-Reprint 2021.

Reference Books:

1. Higher Engineering Mathematics, B.V. Ramana, Mc. Graw Hill Education (India)Pvt. Ltd, New Delhi, 11th Edition, Reprint 2010.
2. Linear Algebra: A Modern Introduction, D Poole, 2nd Edition, Brooks/Cole, 2005.
3. A Text Book of Engineering Mathematics, N.P. Bali and Manish Goyal, LakshmiPublications, Reprint 2008.

Course Title	Object Oriented Programming Through JAVA					B.Tech AI&ML II Sem (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2039205	**ES**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 90 Minutes					**End Exam Duration: 3Hrs**			

Course Objectives:

- Understanding Object-Oriented Programming Concepts.
- Explain variables, strings, operators and datatype.
- Advantage of using Java API classes
- Understand and implement Exceptions and handling.
- Understanding and implement multithreading.
- Understand the need for Lambda expressions and implementing Java database connectivity.

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	How to develop java programs using objects and classes.
CO 2	Implementing programs on arrays and static numbers.
CO 3	Implementing programs using abstract classes and interfaces.
CO 4	Understanding java threads and collection frame work.
CO 5	Implementing programs using Lambda expressions and GDBC programs using Data Access objects.

UNIT-I

Object Oriented Concepts: Introduction to all the components of Object-Orientconcepts.

Overview of Java Platform: History of the Java program.

Java Language Fundamentals: Datatypes, variables, operators, programming constructs and arrays.

UNIT-II

Creating Classes and Objects: About Java classes, objects, overloading, static members and initialization blocks.

Implementing OOP Concepts: About encapsulation, aggregation, inheritance, cosmic class, polymorphism, abstract classes and interfaces.

Useful Java API Classes: Java Application Programming Interfaces (API), wrapper class.

UNIT-III

Exceptions: Java exception declaration and handling customer exceptions

File Handling: about files, folder, Stream API and its implementation. Also discusses about serialization.

UNIT-IV

Multithreading: Threading in java and advanced concepts of handling multi-threads inJava.

Collection Framework: generic, collection framework and how to compare objects..

UNIT-V

Lambda Expressions: About lambda expressions, type inference and its functionality.

JDBC: The database connectivity and Java database connectivity API to apply in the Javaprograms

Text Books:

1. Java; the complete reference, 7^{th} Edition, HerbertSchildt, TMH.
2. Understanding OOP with Java, updated edition, T.Budd, Pearson Education.

Reference Books:

1. An Introduction to programming and OO design using Java, J.Ninoand F.A.Hosc h, Johnwiley & sons.
2. An introduction to Java programming and Object Oriented Application development, R.A.Johnson- Thomson.
3. Core Java2, Vol1, Fundamentals, Cay.S.Horstmann and Gary Cornell,eighth Edition, Pearson Education.
4. CoreJava2, Vol2, Advanced Features, Cay.S.Horstmann and Gary Cornell, eighth Edition, Pearson Education.
5. Object Oriented Programming through Java, P.Radha Krishna, University Press.

Course Title	Principles of Measurements and Sensors					B.Tech AI&ML II Sem (R20)		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2014206	ES	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 90 Minutes					End Exam Duration: 3Hrs			

Course Objectives:

- Familiarize the students about a basic understanding of the principals involved in measurements.
- To know the state-of-the-art sensors for various engineering applications.
- To learn about interface the sensors with computing platforms.
- To impart the students to understand the engineering applications of various sensors.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	To develop a basic understanding of the principals involved in measurements.
CO 2	To introduce the state-of-the-art sensors for various engineering applications.
CO 3	To enable the students to interface the sensors with computing platforms.
CO 4	To facilitate the students to understand the engineering applications of varioussensors.

UNIT-I

Introduction to measurement systems- Generalized measurement model -Static and Dynamic Characteristics of measurement systems- Types of errors- Calibration.

UNIT-II

Principles and Applications of sensing elements- Thermal sensors, Mechanical sensors, Optical Sensors

UNIT-III

Principles of Resistive transducers- Potentiometer, Strain gauge, Inductive transducers- LVDT, Proximity transducers capacitive transducers- Capacitor microphone, capacitive thickness Transducers.

UNIT-IV

Sensors, Transducers-classification of transducers-types of sensor, smart sensors, fiber optic sensors, MEMS, nano sensors, Ultrasonic Sensors, Thin Film Sensors, Liquid Level Sensors

UNIT-V

Data Acquisition System (DAS)-Objective of DAS-Signal conditioning circuit-Multichannel DAS-Computer based DAS.

Text Books:

1. Sawhney. A.K**,** “A Course in Electrical and Electronics Measurements and Instrumentation”, 18th Edition, DhanpatRai& Company Private Limited,2007.
2. Renganathan. S,“Transducer Engineering”, Allied Publishers, Chennai, 2003.
3. Murthy.D.V.S, “Transducers and Instrumentation”, Prentice Hall of India, 2001

Reference Books:

1. Doebelin. E.A, “*Measurement Systems – Applications and Design*”, Tata McGraw Hill, New York, 2000.

2. Patranabis. D, “*Sensors and Transducers*”, Prentice Hall of India, 1999.

<table>
<tr><td>Course Title</td><td colspan="5">Data Structures Lab</td><td colspan="3">B.Tech AI&ML II Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039207</td><td rowspan="2">ES</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5"></td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
• To make the students learn the implementation of insertion, deletion and display operations on various linear and non linear data structures.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand and implement stack ADT, queue ADT and linked list.</td></tr>
<tr><td>CO 2</td><td colspan="8">Able to understand and implement tree traversal algorithms and graph traversal algorithms.</td></tr>
<tr><td>CO 3</td><td colspan="8">Able to implement various sorting algorithms.</td></tr>
<tr><td>CO 4</td><td colspan="8">Analyze and implement searching techniques.</td></tr>
</table>

List of Experiments:

Sample list of Experiments:

1) Write a program for stack operations by using arrays.
2) Write a program for stack operations by using linked list.
3) Write a program to convert given infix expression to postfix expression.
4) Write a program for queue operations by using arrays.
5) Write a program for queue operations by using linked list.
6) Write a program for circular queue operations by using arrays.
7) Write a program to implement operations on single linked list.
8) Write a program to implement operations on doubly linked list.
9) Write a program to implement insertion, deletion and traversal operations ontrees.
10) Write a program to implement Breadth First Search (BFS) traversal algorithm.11)Write a program to implement Depth First Search (DFS) traversal algorithm.
12) Write a program to implement operations on AVL tree.
13) Write a program that implement selection sort, to sort a given list of elements inascending order.
14) Write a program that implement insertion sort, to sort a given list of elements inascending order.

15) Write a program that implement bubble sort, to sort a given list of elements inascending order.

16) Write a program that implement merge sort, to sort a given list of elements inascending order.

17) Write a program that implement quick sort, to sort a given list of elements inascending order.

18) Write a program that implement heap sort, to sort a given list of elements inascending order.

19) Write a program for linear search using arrays.

20) Write a program for binary search using arrays.

Text Books:

1. An Introduction to Data Structures with applications, Jean Paul Trembley and Paul G. Sorenson, McGraw Hill.
2. Fundamentals of Data Structures in C, Horowitz, Sahni, Anderson Freed,Universities press.
3. Introduction to Data Structures in C, Ashok N Kamthane, Pearson Education

Reference Books:

1. Data Structures and Algorithms in C++, S.Sahni, University Press (India) Private Limited, Second Edition.
2. Data Structures using C and C++, Langsam, Augenstein and Tanenbaum, PHI.
3. Data Structures and Algorithms Analysis in C, Mark Allen Weiss, Pearson

Course Title	Communication Skills Lab					B.Tech AI&ML II Sem (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2024209	**HS**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		0	**0**	**3**	**1.5**	**40**	**60**	**100**
					End Exam Duration: 3Hrs			

Course Objectives:

- Expose to a variety of self instructional, learner friendly modes of language learning.
- Learn better pronunciation through stress, intonation and rhythm.
- Train the students to use language effectively to face interviews, group discussions,and public speaking.
- Make them fluent in error- free communication.
- Improve their listening skills by enhancing their accuracy in pronunciation.

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	Develop language skills and vocabulary for professional success.
CO 2	Make the students thorough with presentation skills and become successful.
CO 3	Enhance confidence and become effective communicator.
CO 4	Heighten their fluency in communication.
CO 5	Analyze interview techniques and get success at interviews.

Syllabus:

Topics for the lab:

1. Listening Skills
2. Vocabulary
3. Situational Conversations
4. Interpersonal Skills\
5. Introducing oneself
6. Role-play
7. Group Discussion
8. Interview Skills.

Suggested Software

- Walden Infotech
- K-Van solutions

1. Minimum Requirements

The English Language Lab shall have two parts:

The Computer aided Language Lab for 60 students with 60 systems, one master console,LAN facility and English language software for self-study by learners.

The Communication Skills Lab with movable chairs and audio-visual aids with a P.ASystem, a TV, A digital stereo-audio and video system, Camcorder etc.

System Requirement (Hardware Component):

Computer network with LAN with a minimum of 60 multimedia systems with thefollowing specifications:

P-IV Processor, Speed-2.8 GHz, RAM_512 MB minimum, Hard Disk-80 GB, Headphones

Books Suggested for Professional Communication Lab (to be located within the lab inaddition to the CDs of the text book which are loaded on the systems):

1. **Technical writing and professional communication, Huckin and Olsen** Tata McGraw-Hil 2009.
2. **Technical Communication**byMeenakshi Raman &Sangeeta Sharma, Oxford University Press 2009.
3. **The ACE of Soft Skills** by Gopal Ramesh and Mahadevan Ramesh, Pearson Education, 2010.
4. **Resume's and Interviews** by M. Ashraf Rizvi, Tata McGraw-Hill, 2008.
5. **English Language Communication: A Reader cum Lab Manual**Dr A Ramakrishna Rao, Dr G Natanam& Prof SA Sankaranarayanan, Anuradha Publications, Chennai 2008.

Course Title	JAVA Programming Lab					B.Tech AI&ML II Sem (R20)		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2039208	ES	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		0	0	3	1.5	40	60	100
					End Exam Duration: 3Hrs			

Course Objectives:

- To teach fundamentals of object oriented programming in Java. Understand various concepts of JAVA. To familiarize Java environment to create, debug and run simple Java programs.
- To be able to understand Primitive data types, Java control flow, Methods, classes, packages, multithreading and exception handling
- To be able to understand and implement Java applications and applets

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Create, compile, and run Java program.
CO 2	Apply the concept of inheritance and polymorphism.
CO 3	Implement Packages, Interfaces and Exception handling.
CO 4	Develop windows applications both for standalone and Applets programs by usingawt and swings.

List of Experiments:

EXERCISE 1: (Basics)

a) The Fibonacci sequence is defined by the following rule: The first two values in the sequence are 1 and 1. Every subsequent value is the sum of the two values preceding it. Write a Java program that uses both recursive and non recursivefunctions to print the nth value in the Fibonacci sequence.
b) Write a Java program that prompts the user for an integer and then prints out all prime numbers up to that integer. (use Scanner class to read input)

EXERCISE 2 (Basics)

a) Write a Java program to multiply two given matrices.
b) Write a Java Program that reads a line of integers, and then displays each integer,and the sum of all the integers (Use String Tokenizer class of java.util)
c) Write a Java program that checks whether a given string is a palindrome or not.Ex: MADAM is a palindrome.

EXERCISE 3:(Class, Objects)

a) Write a JAVA program to implement class mechanism. – Create a class, methodsand invoke them inside main method.

EXERCISE 4: (Methods)

a). Write a JAVA program to implement constructor overloading.

b). Write a JAVA program implement method overloading.

EXERCISE 5: (Inheritance)

a). Write a JAVA program to implement Single Inheritance

b). Write a JAVA program to implement multi level Inheritance

c). Write a java program for abstract class to find areas of different shapes

EXERCISE 6: (Inheritance - Continued)

a). Write a JAVA program give example for “super” keyword.

b). Write a JAVA program to implement Interface. What kind of Inheritance can beachieved?

EXERCISE 7:(Threads & Packages)

a) . Write a JAVA program that creates threads by extending Thread class .First thread display “Good Morning “every 1 sec, the second thread displays “Hello “every 2 seconds and the third display “Welcome” every 3 seconds ,(Repeat the same by implementing Runnable)

b) Write a Java program to implement packages.

EXERCISE 8: (Exception Handling)

a).Write a JAVA program that describes exception handling mechanism

b). Write a JAVA program that implements Runtime polymorphism

EXERCISE 9: (Applet)

a) Write a JAVA program to display analog clock using Applet.

b) Write a JAVA program to create different shapes and fill colors using Applet.

c) Write a Java program to develop an applet that receives an integer in one text field, and computes its factorial Value and returns it in another text field, when the button named “Compute” is clicked.

EXERCISE 10: (Event Handling)

a) Write a Java program for handling mouse events.

b) Write a Java program for handling keyboard events.

EXERCISE 11: (Swings)

a) Write a Java program that works as a simple calculator. Use a grid layout to arrange buttons for the digits and for the +, -,*, % operations. Add a text field to display the result.(Real Time)

b) Write a JAVA program that to create a single ball bouncing inside a JPanel

<table>
<tr><td>Course Title</td><td colspan="5">Community work / NSS</td><td colspan="3">B.Tech AI&ML II Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20MC211</td><td rowspan="2">MC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>2</td><td>--</td><td>--</td><td>--</td><td>40</td><td>--</td><td>40</td></tr>
<tr><td colspan="6">Mid Exam Duration: 90 Minutes</td><td colspan="3"></td></tr>
<tr><td colspan="9">Course Objectives:
• To inculcate volunteerism concept in the young minds.
• To impart nationalism, self-sustainability and responsibilities in youth.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">To recall history, objectives and principles.</td></tr>
<tr><td>CO 2</td><td colspan="8">Planning and understanding the various NSS Programs.</td></tr>
<tr><td>CO 3</td><td colspan="8">To inculcate volunteerism.</td></tr>
<tr><td>CO 4</td><td colspan="8">To understand youth and their responsibilities towards community.</td></tr>
<tr><td>CO 5</td><td colspan="8">To impart self-sustainability.</td></tr>
</table>

UNIT- I

- Introduction, Basic aspects of NSS, NSS programs & activities
- History, philosophy, aim & objectives of NSS, flag, emblem, song etc
- Structure, role, responsibilities of NSS functionaries and duties of NSS.
- Concept of regular, special campaign, basis of adoption of village / slum

UNIT- II

- Planning and Preparation of Special Camping Programme
- Program Planning at various levels such as state level, University /+2 level,College level. Monthly action plan.
- Other Youth supporting organizations

UNIT-III

- Volunteerism, Role of Youth leaders, Capacity building in youth
- Indian Tradition of volunteerism, needs & importance, motivation andconstraints of volunteerism.
- Meaning, types of leadership, qualities of a good leader, traits of leadership,Importance and role of youth leadership.
- Understanding youth, identifying the needs draw backs in youth and impalingthe youth to reach their goals.

UNIT-IV

- Youth Development programs in Indian, Youth & Environment, Youth & Health
- National Youth Policy, Youth development Programs, Youth focused and Youthled organizations.
- Environment conservation, enrichment and sustainability, climate change, waste management, natural resource management, Role of youth in disasters.
- Healthy lifestyles, HIV/Aids, Drugs and substance abuse, first aid, food nutrition, national health program, reproductive health: Yoga as a tool for healthy lifestyle.

UNIT- V

- Entrepreneurship development, resources mobilization, additional life skills, documentation and reporting
- Definition & meaning of entrepreneur, qualities of a good entrepreneur steps /ways in opening an enterprise, role of finical and support service.
- Writing a project proposal, tie upping with likeminded organizations, crowdfunding.
- Positive thinking self-confidence and self-esteem, setting life goals and workingto achieve them, management of stress including time management.
- Collection and data analysis, preparation of reports, dissemination of documents.

Text Books:

1. National Service Scheme by Dr. S. Jyothi and A. Uma Shankar Kumar, first edition-2021, Professional Book Publisher.

Reference Books:

1. National Service Scheme – A youth Volunteers Programme by J.D.S Panwar, Amit Kumar Jain and Brijesh Kumar Rathi publications: ASTRAL.

B.Tech III SEM AI&ML (R20)

Course Title	**Probability And Optimization**				**B.Tech. III Sem (R20UG) AI & ML**			
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2021303	**BSC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 90 minutes					**End Exam Duration: 3Hours**			

Course Objectives:

- To help the students in getting a thorough understanding of the fundamentals of probability.
- The course is intended to identify and develop operations research models, understand the mathematical tools to solve optimization problems and develop a report that describes the model, the solving techniques and analyze the results.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the concepts of Probability.
CO 2	Apply the concepts of random variables.
CO 3	Understand various concepts of Operations research.
CO 4	Apply linear programming to optimization techniques.
CO 5	Analyze Transportation problem.

UNIT-I

Probability:

Probability, Sample space and events, Axioms of Probability, Conditional Probability, Baye's theorem.

UNIT-II

Random variables:

Discrete random variables, Continuous random variables, Probability distribution function, Discrete and continuous probability distribution, Mathematical Expectation, Variance and standard deviation of probability distribution.

UNIT-III

Introduction to Operations research:

Introduction, Models of Operations research, Advantages of Operations research, Limitations of Operations research**.**

UNIT- IV

Linear Programming:

Linear programming, Assumptions of linear programming, Properties of linear programming, Development of LP models, Graphical method, Simplex method.

UNIT-V

Transportation Problem:

Transportation problem, Mathematical model for transportation problem, Types of transportation problem, Starting solutions: North- West corner rule, least cost method, Vogel's approximation method.

Text Books:

1. Probability and Statistics for Engineers and Scientists, Walpole and Myers, Seventh edition, Pearson Education Asia, 2002
2. Probability and Statistics for Engineers, Johnson, Fifth edition, Prentice Hall of India.
3. Operations Research by R. Pannerselvam, PHI Publications, 2nd Edition, 2012
4. Operations Research by N.K.Tiwari, Shishir K. Shandilya Prentice-Hall of India.

Reference Books:

1. Probability and Statistics by E. Rukmangadachari & E. Keshava Reddy, Pearson Publishers.
2. Statistical Methods by S.P.Gupta, S Chand Publications, 44th revised edition 2014.
3. Engineering Optimization by Singiresu S.Rao New Age International Publishers.
4. Engineering Mathematics by Srimanta Pal, Subodh C. Bhunia, Oxford University Press.

Course Title	Discrete Mathematics & Graph Theory					B.Tech. III Sem (R20UG) AI & ML		
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
2039302	**PCC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 90 mins						**End Exam Duration: 3Hrs**		

Course Objectives:

❖ To introduce the concepts of mathematical logic.

❖ To introduce the concepts of sets, relations and functions.

❖ To perform the operations associated with sets, functions and relations.

❖ To introduce generating functions and recurrence relations.

❖ To use Graph Theory for solving problems

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	Demonstrate knowledge on mathematical logic and Analyze truth tables, normal forms, implications, rules of inference
CO 2	Understand the basic principles of mathematical objects such as sets, relations
CO 3	Apply basic counting techniques to solve combinatorial problems
CO 4	Able to solve recurrence relations
CO 5	Demonstrate different traversal methods for trees and graphs

UNIT – I

Mathematical Logic: Introduction, Statements and notations, Connectives, Well-formed formulas, Tautologies and contradictions, Equivalence of Formulas, duality law, Tautological Implications, Normal forms, The theory of inference for the statement calculus, rules of inference.

UNIT – II

Relations and Ordering: Relations, Properties of Binary Relations in a Set, Equivalence Relations, operations on relations, representations of relations, Composition of Binary Relations, Compatibility Relations, Partial Ordering relations, Hasse diagram (or) Poset diagram.

UNIT – III

Elementary Combinatorics: Basics of counting, Combinations and Permutations, Enumeration of Combinations and Permutations (without repetition), Enumerating Combinations and Permutations with repetitions.

UNIT – IV

Recurrence Relations: Generating functions of sequences, calculating coefficients of generating functions, Recurrence relations, solving recurrence relations by substitution and characteristic roots, solutions of Inhomogeneous Linear recurrence relations.

UNIT – V

Graphs: Basic Concepts, Isomorphism and Sub graphs, Trees and their Properties, Spanning Trees, Directed Trees, Binary Trees, Planar Graphs, Euler's Formula, Multi graphs and Euler circuits, Hamiltonian graphs, Chromatic Numbers, The Four-Colour Problem.

Text Books:

1. Discrete Mathematics and its applications, 6th edition, K.H.Rosen, TMH.

   (for UNITS-I, II & V)

2. Discrete Mathematics for Computer Scientists & Mathematicians, 2/e, J.L.Mott, A.Kandel, T.P.Baker, PHI. (for UNIT-III)

3. Mathematical Foundations of Computer Science (Discrete Structures). Dr. D.S.C., Prism Publications (for UNIT-IV)

4. Elements of Discrete Mathematics- A Computer Oriented Approach,C.L.Liu,D.P. Mohapatra,3/e, TMH.

Reference Books:

1. Discrete and Combinatorial Mathematics- An Applied Introduction, Ralph. P. Grimaldi, 5/e, Pearson Education.

2. Discrete Mathematical Structures, Mallik and Sen, Cengage Learning.

3. Discrete Mathematical Structures, BernandKolman, Robert C. Busby, SharonCutler Ross, PHI/Pearson Education.

4. Discrete Mathematics with Applications, ThomasKoshy, Elsevier.

5. Discrete Mathematics, Lovasz, Springer.

<table>
<tr><td>Course Title</td><td colspan="5">Digital Systems And Computer Organization</td><td colspan="3">B.Tech. III Sem (R20UG) AI & ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039303</td><td rowspan="2">PCC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
❖ To understand the basic theoretical concepts of digital systems like the binary system and Boolean algebra.
❖ To express real life problem in logic design terminology.
❖ To design logic circuits using combinational/sequential logic.
❖ To understand the Instruction execution stages.
❖ To explain the functions of the memory and concepts of pipelining</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand significance of number systems, conversions, binary codes (L2)</td></tr>
<tr><td>CO 2</td><td colspan="8">Apply different simplification methods for minimizing Boolean functions (L3)</td></tr>
<tr><td>CO 3</td><td colspan="8">Illustrate knowledge on design of various combinational circuits, sequential logic circuits and analyze the operation of flipflops, registers, counters (L3)</td></tr>
<tr><td>CO 4</td><td colspan="8">Discuss the basic structure and organization of computers (L2)</td></tr>
<tr><td>CO 5</td><td colspan="8">Understand the concept of Pipelining and Memory</td></tr>
</table>

UNIT – I

Binary Systems: Binary Numbers, Number base conversions, Octal and Hexadecimal Numbers, complements, Binary codes.

Boolean Algebra and Logic Gates: Basic theorems and properties of Boolean algebra, Boolean functions, canonical and standard forms, Digital logic Gates.

Gate - Level Minimization: The map method, Four-variable map, Five-variable map, Product of sums (POS) simplification, Don't-Care conditions, NAND and NOR implementation.

UNIT – II

Combinational Logic: Combinational Circuits, Analysis of Combinational circuits, Code -converters, Binary adder-subtractor, Decimal Adder, Decoders, Encoders, Multiplexers.

Sequential Logic: Sequential circuits, Latches, Flip-Flops, State Reduction and Assignment.

UNIT – III

Registers, Counters & Programmable Logic Devices: Registers, Shift Registers, Ripple counters, synchronous counters.

Basic Structure of Computers: Computer types, Functional units, Basic operational concepts, Bus structures.

UNIT – IV

Basic Computer Organization and Design: Computer instructions, Instruction cycle, Memory Reference Instructions, Input – Output and Interrupt, Addressing modes.

Micro Programmed Control: Control memory, Address sequencing, Design of control unit, Hard wired control.

UNIT – V

Memory Organization: Memory hierarchy, main memory, associative memory, cache memory, virtual memory.

Input or Output Organization: Input or output Interface, asynchronous data transfer, priority interrupt, direct memory access.

Text Books:

1. Digital Design: With an introduction to the Verlog HDL, VHDL and System Verilog – 6thedition, M. Morris Mano and Michael D. Ciletti, Pearson Education/PHI.
2. Fundamentals of digital logic design with VHDL By Stephen Brown and I Zvonko Vranesic, second edition, The McGraw-Hill.
3. Fundamentals of logic design, Roth, 5th edition, Thomson publications.
4. Computer Organization – Carl Hamacher, Zvonks Vranesic, Safea Zaky, Vth Edition, McGraw Hil.
5. Computer Systems Architecture – M. Moris Mano, III rd Edition, Pearson/PHI.

Reference Books:

1. Switching and Finite Automata Theory by Zvi. Kohavi, Tata McGraw Hill.
2. Switching and Logic Design, C.V.S. Rao, Pearson Education
3. Digital Principles and Design –Donald D. Givone, Tata McGraw Hill, Edition. 6.
4. Fundamentals of Digital Logic & Micro Computer Design, 5TH Edition, M. Rafiquzzaman John Wiley.
5. Computer Organization and Architecture – William Stallings Sixth Edition, Pearson/PHI.
6. Structured Computer Organization – Andrew S. Tanenbaum, 4th Edition, PHI/Pearson.
7. Fundamentals of Computer Organization and Design, - Sivaraama Dandamudi, Springer Int. Edition.

<table>
<tr><td colspan="1">Course Title</td><td colspan="5">Introduction To Artificial Intelligence</td><td colspan="3">B.Tech. III Sem (R20UG) AI & ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039304</td><td rowspan="2">PCC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 mins</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- ❖ To understand how a computer making intelligent decisions.
- ❖ To understand the notions of state space representation, heuristic search methods.
- ❖ To learn different knowledge representation techniques
- ❖ To understand the applications of AI.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Know the strength & Weakness of AI.
CO 2	Given a search problem, analyze and formalize the problem (as a state space, graph, etc.).
CO 3	Ability defines admissible and consistent heuristics and completeness and optimality.
CO 4	Ability to represent knowledge using Logic.
CO 5	Ability to understand the concept of Fuzzy logic system.

UNIT-I

Introduction to AI: Definition, Approaches of AI, History, Application of an AI, What is an AI Technique?

UNIT- II

Problem, Problem Definition, Problem Space and Search, Example Problems: Tic-Tac-Toe, Water Jug problem.

UNIT -III

Uniformed search strategies – Breadth first search, depth first Search.
Heuristic Search Techniques- Hill climbing, A*, AO* Algorithms, Problem reduction.

UNIT- IV

Approaches to Knowledge Representation, Using Predicate Logic, Declarative Vs Procedural Knowledge.

UNIT- V

Fuzzy Logic System: What is Fuzzy Logic ?, Applications, Example Problem.

Text Books:

1. Rich, Knight, Nair: Artificial intelligence, Tata McGraw Hill, Third Edition 2009.
2. Russell, Norvig: Artificial intelligence, A Modern Approach, Pearson Education, Second Edition. 2004.
3. Philip C Jackson, Introduction to Artificial Intelligence: Second, Enlarged Edition.
4. Saroj Kaushik. Artificial Intelligence. Cengage Learning, 2011.

Reference Books:

1. Charu C. Aggarwal,Artificial Intelligence,Springer,2021.
2. Adelyn Zhou, Mariya Yao and Marlene Jia Applied Artificial Intelligence: A Handbook for Business Leaders, 2017.
3. Peter Norvig, Paradigms of Artificial Intelligence Programming: Case Studies in Common Lisp.
4. Dr. Dheeraj Mehrotra,Basics of Artificial Intelligence & Machine Learning
5. Chandra S.S.V,Artificial Intelligence and Machine Learning
6. Denis Rothman, Artificial Intelligence by Example.

Web Links:

- https://onlinecourses.nptel.ac.in/noc22_cs56/preview
- https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_fuzzy_logic_systems.htm

Course Title	**RDBMS**					**B.Tech. III Sem (R20UG) AI & ML**		
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
2039305	**PCC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 90 mins					**End Exam Duration: 3Hrs**			

Course Objectives:

- ❖ Understanding Database Concepts, Database Storage, Entities and Relationships, Relational Data Model, Normalization, Database Design and Performance Tuning.
- ❖ To be able to Database Design and Performance Tuning, Creating Database Objects, Manipulating Data, JDBC As the Fundamental Java API, JPA as the JAVA ORM API, Database Security, Understanding Database Backup and Restore, Introduction of MySQL.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Explain the database concepts like tables and different keys, Install SQLite, MySQL and DB2
CO 2	Explain database normalization, clustered as well as non-clustered indexes, Create Indexes in database
CO 3	Understand concepts like entities, attributes, data modelling and relationship in RDBMS
CO 4	Understand the Relational Data Model in RDBMS, Understand concepts like database views and data dictionary
CO 5	Understand the Database Normalization and all the database normal forms
CO 6	Understand the tuning of database
CO 7	Understand how DDLs used to create or modify the Schema, tables index etc.
CO 8	Understand how DMLs used to store, manipulate, retrieve data from tables
CO 9	Understand on how to create Database and to connect through Java API, and CRUD operations using Java API
CO 10	Understand on how to adopt JPA from JDBC and CRUD operation using JPA
CO 11	Understand on external security threats, internal threats and the social remedies
CO 12	Understand on different backups, how to take a Database backup, restore point
CO 13	Understand how to insert, delete, select, update, where, drop, create queries in MySQL Database

UNIT – I

Understanding Database Concepts: This chapter provides an overview on database concepts, provides details on database tables, primary keys and foreign keys. Also, it gives detailed steps on installation of SQLite and Dockerized MySQL and DB2 databases.

UNIT – II

Understanding Database Storage: In this chapter, you will get an overview on Database normalization, Indexes and how they are used along with configuring clustered as well as non-clustered indexes in databases.

UNIT – III

Entities and Relationships: This chapter provides an overview on entities and relationships in RDBMS and explains concepts like Domains, Relationship and Business rules, Data Modelling and Schemas etc.

UNIT – IV

The Relational Data Model: This chapter provides an overview on Database relations, primary keys and how to represent the data relationships in RDBMS. This chapter also explains about views and Data dictionary in RDBMS.

UNIT – V

Normalization: This chapter provides an overview on the Database Normalization and all the database normal forms (from first till sixth) and Boyce-Codd Normal form.

UNIT – VI

Database Design and Performance Tuning: This chapter provides an overview on the performance and tuning of a database.

UNIT – VII

Creating Database Objects: This chapter provides an overview of Data definition language and its operation.

UNIT – VIII

Manipulating Data: This chapter provides an overview of Data manipulation language and its operation.

UNIT – IX

JDBC As the Fundamental Java API: This chapter provides an overview on JDBC Basics.

UNIT – X

JPA as the JAVA ORM API: This chapter provides an overview of JPA

UNIT – XI

Database Security: This chapter provides an overview of Database Security on External Security threats, Internal threats.

UNIT – XII

Understanding Database Backup and Restore: This chapter provides an overview of Data Backup and Restore.

UNIT – XIII

Introduction to MySQL: This chapter provides an overview of basics of MySQL, basic queries.

<table>
<tr><td>Course Title</td><td colspan="5">Skill Course – I (MAT Lab Programming)</td><td colspan="3">B.Tech. III Sem (R20UG) AI & ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039306</td><td rowspan="2">PCC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>1</td><td>0</td><td>2</td><td>2</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 mins</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
❖ The main objective of the course is to make the students familiar with scripts, functions, control flow and plotting in MATLAB and use it to solve various engineering problems.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Able to understand basic MATLAB features, arrays.</td></tr>
<tr><td>CO 2</td><td colspan="8">Able to analyze various control flow structures.</td></tr>
<tr><td>CO 3</td><td colspan="8">Able to solve linear equations</td></tr>
<tr><td>CO 4</td><td colspan="8">Able to plot two-dimensional graphics</td></tr>
</table>

MODULE-I

Basics of MATLAB: Basic features, script M-files, code cells, arrays creation, addressing and array operations; multi-dimensional arrays, Arithmetic & Logical operators.

MODULE-II

Control Flow: control flow - if, if-else, for, while constructions
Mathematical Operations: Matrix algebra and solutions to systems of linear equations, polynomials.

MODULE-III

MATLAB Graphics & Numerical techniques: Two-dimensional graphics: plot function- line styles, Markers and colors – grids – axes box – labels - multiple plots – subplots – interactive plotting tools – specialized 2-D plots- interpolation, curve fitting.

Text books

1. Mastering MATLAB by Hanselman, Littlefield – Pearson Publications, 1st Edition, 2012.
2. MATLAB Programming by David C. Kuncicky -Prentice Hall, 2004

Course Title	Universal Human Values					B.Tech. III Sem (R20UG) AI & ML		
Course Code	Category	Hours / Week			Credits	Maximum Marks		
2024310	HSMC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 90 mins					End Exam Duration: 3Hrs			

Course Objectives:

- ❖ To understand the moral values that ought to guide the Management profession and resolve the moral issues in the profession.
- ❖ To justify the moral judgment concerning the profession.
- ❖ To develop a set of beliefs, attitudes, and habits that engineers should display concerning morality.
- ❖ To create an awareness on Management Ethics and Human Values.
- ❖ To inspire Moral and Social Values and Loyalty.
- ❖ To appreciate the rights of others.

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	Develop appropriate technologies and management patterns to create harmony in professional and personal life.
CO 2	Ensure students sustained happiness through identifying the essentials of human values and skills
CO 3	Get awareness of types of ethical challenges and dilemmas confronting members of a range of professions (business, media, police, law, medicine, research)
CO 4	Bring to bear ethical analysis and reasoning in the light of normative ethics frameworks on a selection of ethical challenges and dilemmas across the chosen range of professions
CO 5	Relate ethical concepts and materials to ethical problems in specific professions and professionalism

UNIT-I

HUMAN VALUES

Morals, Values and Ethics - Integrity - Trustworthiness - Work Ethics - Service Learning - Civic Virtue - Respect for others - Living Peacefully - Caring - Sharing - Courage - Value Time - Co-operation - Commitment - Empathy - Self-confidence - Spirituality - Character.

UNIT - II

ENGINEERING ETHICS

Senses of Engineering Ethics – Variety of Moral issues – Types of inquiry – Moral Dilemmas – Moral Autonomy – Kohlberg’s Theory – Consensus and Controversy – Professions and Professionalism – Professional ideals and virtues.

UNIT – III

ENGINEER’S RESPONSIBILITY FOR SAFETY

Safety and Risk – Assessment of Safety and Risk – Risk benefit Analysis – Reducing Risk – The Government Regulator’s Approach to Risk – Chernobyl Case and Bhopal Case studies.

UNIT- IV

VALUE EDUCATION

Self- exploration- its content and process- natural acceptance- Happiness and Prosperity- Understanding Human relations.

UNIT – V

HOLISTIC PERCEPTION OF HARMONY

Understanding the Harmony in the society- -Universal order- critical appreciation of Human values- Justice, Trust.

Text Books:

1. Mike martin and Roland Scherzinger. "Ethics in Engineering'', McGrow Hill, New York 2005

2. Charles E Harris. Michael S Pritchard and Michael J Rabins. "Engineering Ethics – Concepts and Cases", Thompson Learning 2000.

3. R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93- 87034-47-1

Reference Books:

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999.

2. John R Baatright. "Ethics and the Conduct of Business", Pearson Education 2003.

3. Edmund G Seeabauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University press 2001.

4.JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amar kantak, 1999.

5. A. N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, 2004.

<table>
<tr><td>Course Title</td><td colspan="4">Digital Systems And Computer Organization Lab</td><td colspan="3">B.Tech. III Sem (R20UG) AI & ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039307</td><td rowspan="2">PCC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 mins</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
❖ To study the theory of Boolean algebra and acquire the skills to manipulate and examine Boolean algebraic expressions.
❖ To study the design principles of combinational and sequential circuits.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Apply knowledge of binary systems, logic gates and Boolean functions to minimize and implement digital logic circuit.</td></tr>
<tr><td>CO 2</td><td colspan="8">Design digital logic circuit using combinational and sequential logic to solve engineering problems.</td></tr>
</table>

List of Experiments:

Digital Systems:

1. (a) Study of basic gates and verify through truth table
   (b) Implementation of basic gates with NAND and NOR gates.

2. (a) Implementation of logic circuit for given Boolean Expression
   (b) Design 3-way lamp control using min-terms and maxterms.

3. (a) Design logic circuit for adders and subtractors (half adder, full adder, parallel adder, half subtractor, full subtractor and parallel subtractor
   (b) 4-bit Binary adder cum subtractor.

4. (a) Design combinational logic circuit for BCD to Excess-3 code conversion.
   (b) Design combinational logic circuit for 4-bit Binary comparator.

5. (a) Design 3x8 Decoder.
   (b) Design Priority Encoder.

6. (a) Design 4-bit shift register
   (b) Design asynchronous UP/DOWN counter.

7. (a) Design Synchronous UP counter using D-flipflop
   (b) Design Modulo 6 counters.

Computer Organization:

1. Write ALP to accept a character and display the same character.
2. Write ALP to display a string by reading character by characters.
3. Write ALP to accept a string and display the same string.
4. Write ALP to display a string for 5 times.
5. Write ALP to covert a given character from lower case to upper case
6. Write ALP to covert a given character from upper case to lower case
7. Write ALP to print alphabets both in upper case and lower case
8. Write ALP to determine whether the given character is alphabet or not
9. Write ALP to determine whether the given string is palindrome or not.
10. Write ALP to find the reverse of a given string
11. Write ALP to accept a digit and display the same digit
12. Write ALP to find the sum of two numbers.

Text Books:

1. Digital Design: With an introduction to the Verlog HDL, VHDL and System Verilog – 6thedition, M. Morris Mano and Michael D. Ciletti, Pearson Education/PHI.
2. Fundamentals of digital logic design with VHDL By Stephen Brown and I Zvonko Vranesic, second edition, The McGraw-Hill.
3. Fundamentals of logic design, Roth, 5th edition, Thomson publica.

Reference Books:

1. Switching and Finite Automata Theory by Zvi. Kohavi, Tata McGraw Hill.
2. Switching and Logic Design, C.V.S. Rao, Pearson Education.
3. Digital Principles and Design –Donald D.Givone, Tata McGraw Hill, Edition.
4. Fundamentals of Digital Logic & Micro Computer Design by M. Rafiquzzaman John Wiley, 5TH Edition.

<table>
<tr><td>Course Title</td><td colspan="5">Exploring Data Analysis With R</td><td colspan="3">B.Tech. III Sem (R20UG) AI & ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039309</td><td rowspan="2">PCC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 mins</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
❖ The course enables the students to apply exploring data analysis with R on real time applications.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understanding the basic concepts of R programming</td></tr>
<tr><td>CO 2</td><td colspan="8">Apply critical R programming concepts to handle the data</td></tr>
<tr><td>CO 3</td><td colspan="8">Apply statistical concepts on real data</td></tr>
<tr><td>CO 4</td><td colspan="8">Use linear regression on given data set</td></tr>
<tr><td>CO 5</td><td colspan="8">Apply data visualization using R packages</td></tr>
</table>

List of Experiments:

1. Download, install R and RStudio on windows.
2. Study of basic syntaxes in R

   (a) Write a R program to create a sequence of numbers from 20 to 50, find the mean of numbers from 20 to 60 and sum of numbers from 51 to 91.

   (b) Write a R program to get the first 10 Fibonacci numbers.
3. Implementation of different types of R operators.
4. Study and implementation of various control structures in R.

   (a) Write a R program to check weather given is even or odd.

   (b) Write a R program to find the sum of n natural numbers [1+2+3+…….+n].

   (c) Write a R program to get all prime numbers up to a given number.
5. Write a R program to find factorial of a given number using recursive function.
6. Programs using vectors, matrix, factor and list in R,

   (a) Write a R program to create a vector of a specified type and length. Create vector of numeric, complex, logical and character type of length 6.

   (b) Write a R program to create a matrix taking a given vector of numbers as input and define the column and row names. Display the matrix.

   (c) Write a R program to find the levels of factor of a given vector.

   (d) Write a R program to create a list containing strings, numbers, vectors and a logical value.

7. Programs using statics (apply all statistical concepts using R)
8. Programs using linear regression.
   Consider the “cars” dataset. Assume “cars$dist” as the response variable and “cars$speed” as the predictor variable. Create a model using the lm() function.
9. Write a R program to create data frame and extract specific rows and columns.
10. Study and implementation of data visualization using R packages.

Text Books:

1. Seema Acharya - "Data Analytics Using R”, Jan 01, 2018, Seema Acharya-MC GRAW HILL INDIA (2018).
2. Aczel − Sounder Pandian: "Complete Business Statistics" 7th Edition Complete Business Statistics, Seventh Edition McGraw−Hill Primis.
3. Pierre Lafaye de Micheaux, Remy Drouilhet and Benoit Liquet – “The R Software Fundamentals of Programming and Statistical Analysis”, Springer.

Reference Books:

1. **Robert I. Kabacoff** "R in Action Data analysis and graphics with R" Manning Publications Co 2011.

Journals/Magazines:

1. Journal of Information Organization (JIO)
2. Open Source for You
3. PC Quest.

SWAYAM/NPTEL/MOOCs:

1. https://onlinecourses.nptel.ac.in/noc21_ma35/preview
2. https://www.coursera.org/learn/data-analysis-r

B.Tech IV SEM AI&ML (R20)

<table>
<tr><td>Course Title</td><td colspan="5">Business Economics and Accounting for Engineers</td><td colspan="3">B.Tech. IV Sem (R20UG) AI & ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2025401</td><td rowspan="2">HSMC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 mins</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
❖ To equip the budding engineering student with an understanding of concepts and tools of economic analysis.
❖ To provide knowledge of Business economics through differential economics concepts and theories.
❖ To make aware of accounting concepts to analyze and solve complex problems relating financial related matters in industries.
❖ To understand professional and ethical responsibility and ability to communicate effectively.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the concept of Business Economics and able to apply</td></tr>
<tr><td>CO 2</td><td colspan="8">UnderstandtheProductionfunctionsandapplicationofBusinessEconomicsand Accounts form a king business decision.</td></tr>
<tr><td>CO 3</td><td colspan="8">To Analyze the markets conditions and determine price-output relations.</td></tr>
<tr><td>CO 4</td><td colspan="8">TounderstandtheconceptsofAccountingandabletopreparethefinancialstatementof A business firms.</td></tr>
<tr><td>CO 5</td><td colspan="8">To evaluate, analyze and interpret the financial performance of business.</td></tr>
</table>

UNIT–I

INTRODUCTION TO BUSINESSE CONOMICS

Meaning, Definition, Nature and scope of Business Economics, Demand Analysis: Concept of Demand, Determinants of demand, Law of Demand and its exceptions, Elasticity of Demand –Types, Measurement of Elasticity of Demand, Demand Forecasting – Techniques of Demand Forecasting.

UNIT–II

THEORY OF PRODUCTION AND COST ANALYSIS

Production Functions: Law of variable proportion, Isoquants and Iso cost, least cost combination of inputs, Returns to Scale and Cobb- Douglas production function. Internal and external economies of scale.

Cost Analysis: Cost concepts – Break-Even Analysis (BEA) – Break Even Point – significance and limitations of BEA.

UNIT–III

CLASSIFICATION OF MARKETS AND PRICING METHODS

Markets structures: Perfect and Imperfect competition–Features of Perfect Competition, Monopoly, Monopolistic Competition and Oligopoly. Price- Output determination under perfect competition, monopoly and monopolistic competition– Price rigidity in Oligopoly.

Methods of Pricing – cost plus pricing, marginal cost pricing, skimming pricing, penetration pricing, differential pricing and administrative pricing.

UNIT–IV

INTRODUCTION TO FINANCIAL ACCOUNTING

Definition to Accounting, objective and need for Accounting, Double Entry Book keeping –Accounting process, Journal Ledger, Trial Balance, and Final Accounts– Trading Account, Profit and Loss Account and Balance sheet with problems.

UNIT–V

FINANCIAL ANALYSIS THROUGH RATIOS

Concept of Financial Ratios, Types of Ratios– Liquidity Ratios, Turnover Ratios, Capital Structure Ratios, Profitability Ratios with problems.

Text Books:

1. Introductory Managerial economics for BMS; Mithani DM, PERASON
2. Management science: Principles and world wide application, Salvatore Dominick. PEARSON
3. A.Ramachandra Aryasri: Managerial Economics and Financial Analysis, PEARSON
4. Varshney & Maheswari: Managerial Economics, Sultan Chand Publishers, 2009.
5. Prasad and K.V.Rao: Financial Accounting, Jai Bharath Publishers, Vijayawada.
6. A.R.Aryasri: Managerial Economics and Financial Analysis, TATA McGraw-Hill Publishing Co. Ltd.

Reference Books:

1. Managerial economics (Economics tools for todays Decision Makers),Pal G.Keat, Philip K.Y. Young, Stephen E.Erfle, Sreejata Banerjee, PEARSON

2. P.L Mehtha: Managerial Economics, Sulthan Chand Publishers

3. K K Dewett -Managerial Economics, S. Chand Publishers

4. S.P Jain & K.L Narang: Financial Accounting, Kalyani publishers.

5. M. Sugunatha Reddy: Managerial Economics and Financial Analysis, Research India Publication, NewDelhi,2013.

6. Paul A Samuleson and Williamnordhaus: Economics, Oxford University Publications.

7. M L Jhingan: Micro Economics & Macro Economics, Vrinda Publacations (P)Ltd.

<table>
<tr><td>Course Title</td><td colspan="5">Design And Analysis Of Algorithms</td><td colspan="3">B.Tech. IV Sem (R20UG) AI & ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039402</td><td rowspan="2">PCC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
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<tr><td colspan="5">Mid Exam Duration: 90 mins</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
❖ To understand and apply the algorithm analysis techniques.
❖ To critically analyze the efficiency of alternative algorithmic solutions for the same problem
❖ To understand different algorithm design techniques.
❖ To understand the limitations of Algorithmic power</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Prove the correctness and analyze space and time complexity of an algorithm</td></tr>
<tr><td>CO 2</td><td colspan="8">Understand different algorithm design strategies</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze & Apply standard algorithms</td></tr>
<tr><td>CO 4</td><td colspan="8">Understand Graph/Tree bases applications and appropriate techniques</td></tr>
<tr><td>CO 5</td><td colspan="8">Current trends in non-Deterministic concepts</td></tr>
</table>

UNIT – I

Introduction: What is an algorithm? Algorithm Specification, **Performance Analysis**: Space complexity, Time Complexity**. Asymptotic Notations**: Big-Oh notation (O), Omega notation (Ω), Theta notation (Θ), **Elementary Data Structures**: Set and Disjoint Set (Union and Find).

UNIT- II

Divide and Conquer: General method, Binary search, Finding the maximum and minimum, Merge sort, Quick sort, Strassen's Matrix multiplication.

Greedy Method: General method, Knapsack Problem, Job sequencing with deadlines. Minimum cost spanning trees: Prim's Algorithm, Kruskal's Algorithm.

UNIT- III

Dynamic Programming: General method with Examples, Multistage Graphs, All Pairs Shortest Paths, Single Source Shortest Path, Optimal Binary Search Trees,0/1Knapsack problem), Travelling Sales Person problem.

UNIT- IV

Search and Traversal techniques: Techniques for Binary tree, Technique for Graphs, connected components and spanning tree, Bi connected components and DFS.

Backtracking: General method, N-Queens problem, Sum of sub sets problem, Graph coloring, Hamiltonian cycles.

UNIT- V

Branch and Bound: Travelling Sales Person problem, 0/1Knapsack problem: LC Branch and Bound solution, FIFO Branch and Bound solution.

NP-Complete and NP-Hard problems: Basic concepts on-deterministic algorithms, P, NP, NP-Complete, and NP-Hard classes, cook's theorem.

Text Books:

1. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran," Fundamentals of Computer Algorithms", Galgotia Publications.

2. Levitin, Anany." Introduction to the design & analysis of algorithms" Pearson Education, 2008

3. Parag H.Dave Himanshu B.Dave "Design and Analysis of Algorithms" Pearson Education 2008.

4. Aho, Hopcroft, Ulman,"the Design and Analysis of Computer Algorithms" Pearson Education, 2000.

Reference Books:

1. Introduction to Algorithms, 2/e, T.H. Cormen, C.E. Leiserson, R.L.Rivest and C.Stein, PHI Pvt. Ltd. / Pearson Education.

2. Algorithm Design: Foundations, Analysis and Internet examples, M.T.Goodrich and R.Tomassia, John Wiley and sons.

3. Design and Analysis of Algorithms, S. Sridhar, Oxford Higher Education.

Course Title	**Operating Systems**					**B.Tech. IV Sem (R20UG) AI & ML**		
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
2039403	**PCC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 90 mins					**End Exam Duration: 3Hrs**			

Course Objectives:

- ❖ Have an overview of functions of operating systems.
- ❖ Have a thorough knowledge of process management and memory management.
- ❖ To have a thorough knowledge of how handle to deadlocks.
- ❖ Learn the concepts of files, protection and security

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	Understand the basic concepts related to the operating systems
CO 2	Analyze the various process scheduling algorithms and process synchronization mechanisms.
CO 3	Analyze the various memory management schemes.
CO 4	Understand the ways to deal the deadlocks and the basic concepts related to files in the system.
CO 5	Analyze the protection and security mechanism.

UNIT – I

Operating Systems Basics: Operating systems functions, Overview of computer operating systems, distributed systems, operating system services and systems calls, system programs, operating system structure.

UNIT – II

Process Management: Process concepts, scheduling-criteria, CPU scheduling algorithms,Evaluation of Scheduling Algorithms.

Concurrency: Process synchronization, the critical-section problem, Peterson’s Solution,semaphores, Classic problems of Synchronization, monitors.

UNIT – III

Memory Management: Introduction**,** Swapping, contiguous memory allocation, paging,structure of the page table, segmentation, virtual memory, demand paging, page-replacement algorithms, Allocation of frames.

UNIT – IV

Deadlocks: System model, deadlock characterization, deadlock prevention, detection and avoidance, recovery form deadlock.

Files: The concept of a file, Access Methods, File Allocation Methods, Directory structure, Filesystem mounting, File sharing and Protection.

UNIT – V

Protection: Protection, Goals of Protection, Principles of Protection, Domain of protection, AccessMatrix, Implementation of Access Matrix.

Security: The security problem, Program threats, User authentication.

Text Books:

1. Abraham Silberchatz, Peter B. Galvin, Greg Gagne, Operating SystemConcepts", Eighth edition, John Wiley.

2. Andrew S Tanenbaum, "Modern Operating Systems", Fourth Edition, PearsonEducation.

3. William Stallings, "Operating Systems: Internals and Design Principles", SixthEdition2009, Pearson Education.

4. D.M. Dhamdhere, "Operating Systems, A Concept based Approach", Third Edition,TMH.

Reference Books:

1. A.S. Godbole, "Operating Systems", Second Edition, TMH.

2. Operating Systems: A Spiral Approach – Elmasri, Carrick, Levine, TMH Edition.

3. Operating Systems – H.M. Deitel, P. J. Deitel, D. R. Choffnes, 3rd Edition, Pearson.

4. Operating Systems: A Practical Approach, Rajiv Chopra, 4^{th} Edition, S Chand Publishers.

<table>
<tr><td>Course Title</td><td colspan="5">Data Science</td><td colspan="3">B.Tech. IV Sem (R20UG) AI & ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
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<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 mins</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
• Provide you with the knowledge and expertise to become an efficient data scientist.
• R-Programming code to statistically analyze a dataset.
• Evaluating Data visualizations.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understanding how data is collected, managed and stored for data science</td></tr>
<tr><td>CO 2</td><td colspan="8">Understanding the key concepts in data science</td></tr>
<tr><td>CO 3</td><td colspan="8">Learning R-Programming</td></tr>
<tr><td>CO 4</td><td colspan="8">Understanding social networks</td></tr>
</table>

UNIT- I

Introduction: What Is Data Science? Big Data and Data Science Hype, Getting Past the Hype, Why Now? The Current Landscape (with a Little History), A Data Science Profile, Thought Experiment: Meta-Definition, What Is a Data Scientist, Really?

Statistical Inference, Exploratory Data Analysis, and the Data Science Process: Statistical Thinking in the Age of Big Data, Exploratory Data Analysis, The Data Science Process, Thought Experiment: How Would You Simulate Chaos? Case Study: RealDirect

UNIT - II

Algorithms: Machine Learning Algorithms, Three Basic Algorithms : Linear Regression, k-Nearest Neighbors (k-NN), k-means.

Spam Filters, Naive Bayes, and Wrangling: Learning by Example: Why Won’t Linear Regression Work for Filtering Spam? How About k-nearest Neighbors? Naive Bayes: Bayes Law, A Spam Filter for Individual Words, A Spam Filter That Combines Words: Naive Bayes, Comparing Naive Bayes to k-NN, Web APIs and Other Tools.

UNIT -III

Data Visualization and Fraud Detection: Data Visualization History, What Is Data Science, Redux? A Sample of Data Visualization Projects, Mark's Data Visualization Projects, Data Science and Risk, Data Visualization at Square, Ian's Thought Experiment Data Visualization for the Rest of Us.

UNIT - IV

R-Programming: What is R? Why use R for analytics? How to run R? First R example, functions a short Programming example, some important R data structures, vectors, matrices, lists, R programming structures.

UNIT- V

Social Networks and Data Journalism: Social Network Analysis at Morning Analytics, Social Network Analysis, Terminology from Social Networks, Thought Experiment Morningside Analytics, More Background on Social Network Analysis from a Statistical Point of View, Data Journalism.

Text Books:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly.

2. Norman matloff ,"The art of R programming". No Starch Press, 2009.

3. Thomas A. Runkler, "Data Analytics: Models and Algorithms for Intelligent Data Analysis", Springer Science & Business Media, 2012.

4. Mark Gardener, "Beginning R- The Statistical Programming Language", John Wiley & Sons, Inc.,

Reference Books:

1. Data Science, John D. Kelleher, Brendan Tierney, MIT Press.

2. R in Action Data Analysis and Graphics with R, Robert I. Kabacoff, Manning Publications, 2011.

3. Practical Statistics for Data Scientists, Peter Bruce, Andrew Bruce, O'Reilly Meida.

<table>
<tr><td>Course Title</td><td colspan="5">Business Intelligent Analyst</td><td colspan="3">B.Tech. IV Sem (R20UG) AI & ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039405</td><td rowspan="2">PCC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 mins</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
❖ Basic principles of IOT.
❖ Various IOT platforms and application development.
❖ To know about Arduino board.
❖ To know about Raspberry pi.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">The importance of analytics and how its transforming the world today</td></tr>
<tr><td>CO 2</td><td colspan="8">Understand how analytics provided a solution to industries using real case studies</td></tr>
<tr><td>CO 3</td><td colspan="8">Explain what is analytics, the various types of analytics, and how to apply it</td></tr>
<tr><td>CO 4</td><td colspan="8">Understand how a business analysis software works, and its architecture</td></tr>
<tr><td>CO 5</td><td colspan="8">Describe a reporting application, its interface, and the different report types</td></tr>
<tr><td>CO 6</td><td colspan="8">Create different types of advanced reports</td></tr>
<tr><td>CO 7</td><td colspan="8">Understand Active Reports and how to create them</td></tr>
</table>

MODULE I: ANALYTICS OVERVIEW

Course I – Business Analytics Overview

UNIT-I: Analytics Overview - This unit provides an understanding of the importance of business analytics in our world, society, and life.

UNIT-II: Analytics trends: Past, present & future - This unit explains how analytics has evolved over time

UNIT-III: Towards a predictive enterprise - This unit explains the effects of business analytics in the corporate world that has led to its global adoption across geographies and industries.

UNIT-IV: Analytics: Industry domains - This unit highlights the application of analytics across major industries.

UNIT-V: Case studies and solutions - This unit covers real case studies and solutions of the adoption of business analytics across the world.

Course II – Business Intelligence and Analytics

Business Intelligence and Analytics: This course provides a collection of resources designed for participants to become familiar with business intelligence (BI) and analytics concepts. Participants will review materials to introduce themselves to terminology and practical business use cases for a high level understanding of BI and analytics. The course includes a pre-assessment for participants to measure their understanding of the content before taking the course, and a post-assessment for participants to gauge their learning after reviewing the materials.

MODULE II – BUSINESS ANALYTICS FOUNDATIONS

Course I – IBM Cognos Analytics for Consumers

Business analysis solution for consumers: IBM Cognos Analytics for Consumers (v11.0) will teach IBM Cognos Analytics consumers how to access content, use reports, create dashboards, and personalize the appearance of IBM Cognos Analytics portal.

MODULE III – BUSINESS INTELLIGENCE ANALYST

Course I – IBM Cognos Analytics: Author Reports Fundamentals

UNIT-I: Introduction to IBM Cognos Analytics - In this unit, you will learn about IBM Cognos Analytics, different report types, how to create reports and examine personal data sources and modules.

UNIT-II: Create list reports - In this unit you will learn about how to create list reports.

UNIT-III: Focus reports using filters - In this unit you will learn about how to focus reports using filters.

UNIT-IV: Create crosstab reports - In this unit you will learn about how to create crosstab reports

UNIT-V: Present data graphically - In this unit you will learn about how present data graphically.

UNIT-VI: Focus reports using prompts - In this unit you will learn how to focus reports using prompts.

UNIT-VII: Extend reports using calculations - In this unit you will learn how to extend reports using calculations.

UNIT-VIII: Use additional report building techniques - In this unit, you will learn how to use additional report building techniques.

UNIT-IX: Customize reports with conditional formatting - In this unit you will learn how to customize reports using conditional formatting.

UNIT-X: Drill-through definitions - In this unit you will learn how to drill-through from one report to another.

UNIT-XI: Enhance report layout - In this unit you will learn how to force page breaks in report, modify existing reports, apply formatting and format data and report objects.

Appendix A. Overview of IBM Cognos Analytics - In this appendix you will be introduced to IBM Cognos Analytics

Course II – IBM Cognos Analytics: Author Reports Advanced

UNIT-I: Create query models - In this unit you will learn about creating query models and how to filter query data.

UNIT-II: Create reports based on query relationships - In this unit, you will learn about query relationships and how to combine different queries to generate reports.

UNIT-III: Create advanced dynamic reports - In this unit, you will learn how to create advanced dynamic reports.

UNIT-IV: Design effective prompts - In this unit, you will learn how to design effective prompts to create more efficient reports.

UNIT-V: Create additional advanced reports - In this unit, you will learn how to create additional advanced reports.

UNIT-VI: Examine the report specification - In this unit, you will learn how to examine and modify report specification.

UNIT-VII: Distribute reports through bursting - In this unit, you will learn how to distribute reports through bursting and how to use burst tables

UNIT-VIII: Enhance user interaction with HTML - In this unit, you will learn how to create interacting reports using HTML.

Course III – IBM Cognos Analytics: Author Active Reports

UNIT-I: Introduction to IBM Cognos Active Reports - In this unit, you will learn about creating query models and how to filter query data.

UNIT-II: Use Active Report connections - In this unit, you will use active report connections

UNIT-III: Active Report charts, visualizations, and decks - In this unit, you will learn about active report charts, visualizations, and decks.

<table>
<tr><td>Course Title</td><td colspan="5">Operating Systems Lab</td><td colspan="3">B.Tech. IV Sem (R20UG) AI & ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
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<tr><td>0</td><td>0</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 mins</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
• Have a thorough knowledge of process management and memory management.
• To have a thorough knowledge of how handle to deadlocks
• Have a thorough knowledge on paging and segmentation concepts</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Design, implement and analyze the various process scheduling algorithms and process synchronization mechanisms</td></tr>
<tr><td>CO 2</td><td colspan="8">Understand, implement and analyze the various memory management schemes.</td></tr>
<tr><td>CO 3</td><td colspan="8">Design, implement and analyze the ways to deal the deadlocks in the system.</td></tr>
<tr><td>CO 4</td><td colspan="8">Understand and analyze the paging and segmentation schemes.</td></tr>
<tr><td>CO 5</td><td colspan="8">Understand and analyze the File Allocation Techniques.</td></tr>
</table>

List of Experiments:

1. Write a C/C++ program to simulate the following CPU scheduling algorithms to find the average turnaround time and average waiting time of process.

    i. First Come First Serve

    ii. Shortest Job First

    iii. Priority

    iv. Round Robin Scheduling

2. Write a C/C++ Program to simulate Producer Consumer Problem.

3. Write a C program to simulate the concept of Dining-Philosophers problem.

4. Write a C/C++ program to simulate the following contiguous memoryallocation techniques

    i. First Fit ii. Best Fit iii. Worst Fit

5. Write a C/C++ program to simulate the following page replacement algorithms tofind the total number of page faults for given page reference string.

    i. First In First Out ii. Least Recently Used iii. Optimal

6. Write a C/C++ program to simulate the paging and segmentation concepts.

7. Write a C program to simulate the following:

i. Deadlock avoidance   ii. Deadlock detection

8. Write a C/C++program to simulate the following file allocation

i. Sequential   ii. Indexed   iii. Linked

Text Books:

1. Abraham Silberchatz, Peter B. Galvin, Greg Gagne, "Operating SystemConcepts", Eighth edition, John Wiley.
2. Andrew S Tanenbaum, "Modern Operating Systems", Fourth Edition, PearsonEducation
3. William Stallings, "Operating Systems: Internals and Design Principles", SixthEdition2009, Pearson Education.
4. D.M.Dhamdhere, "Operating Systems, A Concept based Approach", Third Edition,TMH

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1. A.S.Godbole, "Operating Systems", Second Edition, TMH.
2. Operating Systems: A Spiral Approach – Elmasri, Carrick, Levine, TMH Edition
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• Provide you with the knowledge and expertise to become an efficient data scientist.
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<tr><td>CO 4</td><td colspan="8">Understanding social networks</td></tr>
<tr><td>CO 5</td><td colspan="8">Understanding how data is collected, managed and stored for data science</td></tr>
</table>

List of Experiments:

1. Implement on Python Environment setup to work with Data science
2. Write a program an NumPy: Arithmetic Operations on Arrays
3. Generate Pseudo Random numbers using various methods in NumPy
4. Write a program on Pandas: Program to deal with missing data by reading data from a file.
5. Implement on data wrangling functions on raw data
6. Write a program an Matplotlib: Visualize data by plotting a scatter plot.
7. Write a Program to visualize data using pie and bar graphs.
8. Implement programs on Date and Time Data Types
9. Implement Binomial distribution of variable.
10. Implement ANNOVA Tests.
11. Implement Chi-Square Tests
12. Write a program to Find the Normal distribution of a variable.

<u>Text Books</u>:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly.

2. Norman matloff ,“The art of R programming”. No Starch Press, 2009.

3. Thomas A. Runkler, “Data Analytics: Models and Algorithms for Intelligent Data Analysis”, Springer Science & Business Media, 2012.

4. Mark Gardener, “Beginning R- The Statistical Programming Language”, John Wiley & Sons, Inc.,

<u>Reference Books</u>:

1. Data Science, John D. Kelleher, Brendan Tierney, MIT Press.

2. R in Action Data Analysis and Graphics with R, Robert I. Kabacoff, Manning Publications, 2011.

3. Practical Statistics for Data Scientists, Peter Bruce, Andrew Bruce, O'Reilly Meida.

Course Title	Skill Course – II (Advanced Python Programming)					B.Tech. IV Sem (R20UG) AI & ML		
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
2039409	**PCC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		1	**0**	**2**	**2**	**40**	**60**	**100**
Mid Exam Duration: 90 mins					**End Exam Duration: 3Hrs**			

Course Objectives:

- Python is a very powerful programming language used for many different applications. Over time, the huge community around this open-source language has created quite a few tools to efficiently work with Python.
- The course enables the students to learn various python libraries starting from Numpy arrays, Pandas Data Frames, Matplotlib.
- Along the way, they'll learn about data cleaning, feature extraction and object oriented concepts using python.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understanding the basic concepts on Numpy arrays and performs calculations on givendata.
CO 2	Apply critical pandas concepts to handle the data frames.
CO 3	Apply data visualization using matplotlib packages.
CO 4	Analyze object oriented concepts for data reusability.
CO 5	Use data cleaning methods and feature extraction for data science applications.

List of Experiments:

Week-1: Study and implementation of various Basic Slicing and Advanced Indexing operations of NumPy arrays using Python over example data series?

Week-2: Implement the program using python Aggregations like Min, Max, and etc.?
Example: Consider the heights of all US presidents and find the Average Height of prime ministers of America? This data is available in the file "*president_heights.csv*".

Week-3: Write a python Program using Numpy Comparisons, Masks, and Boolean Logic? Example: Consider the series of data that represents the amount of precipitation each day for a year in a given cityand count the Rainy Days.

Week-4: Write a python Program using Numpy Fancy Indexing in single and multiple dimensions by selecting Random Points?

Week-5: Study and implementation of various Pandas operations on

i. Data sets ii. Data Frames iii. Crosstab
iv. Group by v. Filter vi. Missing values

Week-6: Implement the python program using pandas

a) Program to Combining Datasets using Merge.

b) Program to Combining Datasets using joins.

Week-7: Implement the python program using pandas

a) Program using Pandas on Pivot Tables.

b) Program using Pandas to Vectorized String Operations.

Week-8: Program using Pandas to Working with Time Series.

Example: Visualizing Seattle Bicycle Counts data set.

Week-9: Implement the python program for the following matplotlib features

i. Color bars	ii. Annotation	iii. Matplotlib to Text.
iv. Histograms	v. Scatter Plots	vi. Box plot

Week 10: Write the python program to implement various sub packages of Scipy.

Week 11: Write a Python program to create a parent class and child class along with their own methods. Access parent class members in child class to implement the following sceneries.

a) Constructors & destructors

b) Polymorphism

Example: Create a class ATM and define ATM operations to create account, deposit, check_balance, withdraw and delete account. Use constructor to initialize members.

Week-12: Implement the various data cleaning steps of example data sets using python nympy and pandas.

Week 13: Implement the feature selection of data set using appropriate sklearn libraries.

<u>Text Books:</u>

1. Robert Johansson, "Numerical Python: A Practical Techniques Approach for Industry" published by Apress.

2. Daniel Y. Chen, "Pandas for Everyone: Python Data Analysis", First Edition by Addison-Wesley Professional

3. Alvaro Fuentes, “Become a Python Data Analyst” by Packt publishing

4. Paul Barry, “Head First Python a Brain Friendly Guide”, O’Reilly, 2nd Edition, 2016.

Reference Books:

1. Advanced Python Programming By Dr. Gabriele Lanaro, Quan Nguyen, SakisKasampalis by Packt publishing

2. Advanced Python Development: Using Powerful Language Features in Real World Applications By Matthew Wilkes Apress July 2020

3. Expert Python Programming - Fourth Edition By Michal Jaworski and Tarek ZiadePackt Publishing May 2021

4. Modern Python Cookbook - Second Edition By Steven F. Lott Packt Publishing July 2020.

Course Title	Mandatory Course (Constitution Of India)					B.Tech. IV Sem (R20UG) AI & ML		
Course Code	Category	Hours / Week			Credits	Maximum Marks		
20MC409	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		2	1	0	0	40	--	40
Mid Exam Duration: 90 mins					End Exam Duration: 3Hrs			

Course Objectives:

- To realize the significance of the constitution of India to students from all walks of life and help them to understand the basic concepts of Indian constitution.
- To identify the importance of fundamental rights as well as fundamental duties.
- To understand the functioning of Union, State and Local Governments in the Indian federal system.
- To learn procedure and effects of emergency, composition and activities of election commission and amendment procedure.

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	Describe the historical background of the constitution making and its importance for building a democratic India
CO 2	Explain the functioning of three wings of the government i.e., executive, legislative and judiciary.
CO 3	Explain the value of the fundamental rights and duties for becoming good citizen of India
CO 4	Analyze the decentralization of power between central, state and local self government.
CO 5	Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy

UNIT-I

Introduction to Indian Constitution: Constitution meaning of the term, Indian Constitution – Sources and constitutional history, Features – Citizenship, Fundamental Rights and Duties, Directive Principles of State Policy.

UNIT – II

Union Government and its Administration Structure of the IndianUnion: Center- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and C entral Secretariat, LokSabha, RajyaSabha, The Supreme Court and High Court: Powers and Functions.

UNIT – III

State Government and its Administration Governor – Role and Position – CM and Council of ministers, State Secretariat: Organization, Structure and Functions.

UNIT – IV

Local Administration: District's Administration Head – Role and Importance, Municipalities –Mayor and role of Elected Representative – Zilla Panchayat, Elected officials and their roles, CEO Zilla Panchayat: Block level Organizational Hierarchy – (Different departments), Village level – Role of Elected and Appointed officials.

UNIT – V

Election Commission: Election Commission- Role of Chief Election Commissioner and Election Commissioner State Election Commission, Functions of Commissions for the welfare of SC/ST/OBC and women.

Text Books:

1. M.V.Pylee, "Introduction to the Constitution of India",4th Edition, Vikas publication,2005.

2. Durga Das Basu (DD Basu), "Introduction to the constitution of India", (Student Edition),19th edition, Prentice-Hall EEE, 2008.

Reference Books:

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd.. New Delhi

2. Subhash Kashyap, Indian Constitution, National Book Trust

3. J.A. Siwach, Dynamics of Indian Government & Politics

4. D.C. Gupta, Indian Government and Politics

5. H.M.Seervai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)

6. J.C. Johari, Indian Government andPolitics Hans

7. J. Raj IndianGovernment and Politics

8. M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd.. New Delhi

9. Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Righ t), Challenges to Civil Rights Guarantees in India, Oxford University Press 2012.

B.Tech V SEM AI&ML (R20)

<table>
<tr><td>Course Title</td><td colspan="4">Data Mining &
Data Warehousing</td><td colspan="4">B.Tech. V Sem (R20UG) AI&ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039501</td><td rowspan="2">PCC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3 Hrs</td></tr>
</table>

Course Objectives:

- To learn the concepts of database technology evolutionary path which has led to the need for data mining and its applications.
- To develop skills of using data mining techniques for solving practical problems.
- To learn Data mining algorithms to build analytical applications.

Course Outcomes: On successful completion of this course, the students will be able to

CO1	Understand the fundamentals of Data Mining and its Principles.
CO2	Understand different steps followed in Data mining and pre-processing for Datamining.
CO3	Apply appropriate data mining algorithms to find Frequent patterns, Associations, and Correlations.
CO4	Compare and evaluate data mining techniques classification, prediction.
CO5	Cluster the high dimensional data for better organization of the data and to detect the Outliers in the high dimensional data.

UNIT – I

Introduction: Why Data Mining? What Is Data Mining? What Kinds of Data Can Be Mined? What Kinds of Patterns Can Be Mined? Major issues in Data Mining.

UNIT – II

Data Preprocessing:

Why Pre-process the Data? Descriptive Data Summarization, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization and Concept Hierarchy Generation.

UNIT – III

Mining Frequent Patterns, Associations, and Correlations: Basic Concepts andMethods: Basic Concepts, Frequent Itemset Mining Methods, From Association Analysis to Correlation Analysis, Pattern Mining in Multilevel, Multidimensional Space, Constraint-Based Frequent Pattern Mining.

UNIT – IV

Classification: Basic Concepts, Decision Tree Induction, Baye's Classification Method, Rule-Based Classification.

Prediction: Basic concepts, Accuracy and Error measures, Evaluating the accuracy of a classifier or a predictor.

UNIT – V

Cluster Analysis: Cluster Analysis basic concepts, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods.

Outlier Detection - Outliers and Outlier Analysis, Outlier Detection Methods.

Text Books:

1. Data Mining: Concepts and Techniques, Jiawei Han, Micheline Kamberand Jian Pei,Morgan Kaufmann Publishers, Elsevier, Third Edition,2012.
2. Data Warehousing in the Real world, Sam Aanhory & Dennis Murray, PearsonEducation, Asia.
3. Intelligent Data Mining, Da Raun. Guoquing Chen, Etienne E. Kerre. Geert Wets,Springer.
4. Data Mining & Data Warehousing: Principles and Practical Techniques, Parteek Bhatia, Cambridge.

Reference Books:

1. Data Mining Techniques, Arun K Pujari, Second Edition, Universities Press.
2. Insight into Data Mining, K.P. Soman, S. Diwakar, V. Ajay, PHI2008.
3. Data Mining: Introductory and Advanced Topics, Margaret H. Dunhan, Pearson.
4. Data Mining, Vikram Pudi, P. Radha Krishna, Oxford Higher Eduction.

<table>
<tr><td>Course Title</td><td colspan="4">Automata Theory & Compiler Design</td><td colspan="3">B.Tech. V Sem (R20UG) AI&ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039502</td><td rowspan="2">PCC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3 Hrs</td></tr>
</table>

Course Objectives:

- To be able to construct finite state machines and the equivalent regular expressions and prove the equivalence of languages described by finite state machines and regular expressions.
- To be able to construct push down automata and the equivalent context free grammars, Turing machines and Post machines.
- To make the student to understand the process involved in compilation.
- Creating awareness among students on various types of parsers.
- Understand the syntax analysis, intermediate code generation, type checking, and the role of symbol table.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand of the notion of a regular set and its representation by DFA's, NFA's and regular expressions and the notion of a context-free language and its representation.
CO 2	Identify the applications of regular expressions and context-free grammars, Understand the concept of Push Down Automata and Solve to the problems using Turing machines.
CO 3	Understand and analyze the various phases of Compiler and Identify the tokens using lexical analysis, syntax analysis.
CO 4	Categorize and implement parsing techniques, understand syntax directed definition and develop type checking semantics usingsynthesized and inherited attributes.
CO 5	Understand the storage allocation and intermediate code representations, Summarize the code optimize techniques and demonstrate code generation technique and concepts.

UNIT – I

Fundamentals: Strings, Alphabet, Language, Operations, Finite state machine, definitions, finite automaton model, acceptance of strings, and languages, deterministic finite automaton and non-deterministic finite automaton, NFA to DFA conversion, Finite Automata with output-Moore and Mealy machines.

Regular Languages: Regular sets, regular expressions, constructing finite Automata for a given regular expressions, Conversion of Finite Automata to Regular expressions.

UNIT – II

Grammar Formalism: Regular grammars-right linear and left linear grammars, Context free grammar, derivation trees, sentential forms, Chomsky normal form, Grei back normal form, Push down automata, definition, model, acceptance of CFL, Turing Machine, definition, model, design of TM, Universal Turing Machine.

UNIT – III

Introduction to Compiling: Compilers, the phases of a Compiler.

Lexical Analysis: The role of the analyzer. Input buffering, specification of tokens, recognition of tokens.

Syntax Analysis: The role of the parser, writing a grammar, Top down parsing,

UNIT – IV

Parsing: Bottom-up parsing, LR parsers.

Type Checking: Type systems, Specification of type checker, Syntax Directed Definition

Intermediate code generation: Intermediate languages, implementation of three address code

UNIT – V

Code Generation: Issues in the Design of a code generator, Basic blocks and flow graphs, A simple code generator, Register allocation and assignment,

Code Optimization: Introduction, the principle source of optimization.

Text Books:

1. "Introduction to Automata Theory Languages and Computation". Hopcroft H.E. andUllman J. D. Pearson Education.
2. Introduction to Theory of Computation - Sipser 2nd edition Thomson.
3. Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, Compilers-Principles, Techniques and Tools, Pearson Education.

Reference Books:

1. Elements of Theory of Computation", Lewis H.P. & Papadimition C.H. Pearson /PHI.
2. Theory of Computer Science and Automata languages and computation -Mishra and Chandrashekaran,
3. K. Muneeswaran, Compiler Design, Oxforward university press.
4. M. Sreenivasulu, Compiler Design, Research India Publications.
5. K. V. N. Sunitha, Compiler Construction, Pearson Education.

<table>
<tr><td>Course Title</td><td colspan="5">Big Data Engineer</td><td colspan="3">B.Tech. V Sem (R20UG) AI&ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039503</td><td rowspan="2">PCC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
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<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

IBM Skills Academy

Career path description: The Big Data Engineer career path prepares students to usethe Big Data platform and methodologies in order to collectand analyze large amounts of data from different sources. This will require skills in Big Data architecture, such as Apache Hadoop, Ambari, Spark, Big SQL, HDFS, YARN, MapReduce, ZooKeeper, Knox, Sqoop, and HBase.

ibm.com/training

<u>General information:</u>

Delivery Method: 95% instructor led and 5% web-based
Version: 2018
Product: HDP Open Source and IBM Watson Studio

Audience: Undergraduate senior students from IT related academicprograms i.e., computer science, software engineering, information systems and similar others.

Learning Objectives: After completing this course, you should be able to understand the following topics:

- Big Data and Data Analytics
- Hortonworks Data Platform (HDP) & Apache Ambari
- Hadoop and the Hadoop Distributed File System
- MapReduce and YARN
- Apache Spark
- Storing and Querying data
- ZooKeeper, Slider, and Knox
- Loading data with Sqoop
- Data Plane Service & Stream Computing
- Data Science essentials
- Drew Conway’s Venn Diagram - and that of others
- The Scientific Process applied to Data Science
- The steps in running a Data Science project
- Languages used for Data Science (Python, R, Scala, Julia, ...)
- Survey of Data Science Notebooks
- Markdown language with notebooks
- Resources for Data Science, including GitHub
- Jupyter Notebook
- Essential packages: NumPy, SciPy, Pandas, Scikit-learn, NLTK, Beautiful Soup...

- Data visualizations: matplotlib, ..., Pixie Dust
- Using Jupyter "Magic" commands
- Using Big SQL to access HDFS data
- Creating Big SQL schemas and tables
- Querying Big SQL tables & Configuring Big SQL security
- Data federation with Big SQL
- IBM Watson Studio & Analyzing data with Watson Studio

Prerequisites Skills:

- Basic knowledge of Linux
- Basic SQL knowledge
- Working knowledge with big data and Hadoop technologies
- Have a basic understanding of notebook technologies for data science
- Students can attend free courses at www.bigdatauniversity.com to acquire the necessary requirements
- Exposure to the IBM Skills Academy Portal learning environment
- Exposure to the IBM Skills Academy Cloud hands-on labs platform

Duration: 32.7 Hours

Skill Level: Basic – Intermediate

Hardware Requirements:

Classroom (ILT) Setup Requirements:	
Processor	3 GHz or higher
GB RAM	20 GB
GB free disk space	80 GB
Network requirements	Yes
Other requirements	IBM ID

Notes: The following unit and exercise durations are estimates, and might not reflect every class experience. If the course is customized or abbreviated, the duration of unchanged units will probably increase.

<u>Course Agenda</u>

<table>
<tr><td colspan="4">MODULE I – BIG DATA OVERVIEW</td></tr>
<tr><td></td><td colspan="3">Course I – Introduction to the Big Data Ecosystem (Duration: 1.6 Hours)</td></tr>
<tr><td></td><td></td><td colspan="2">Course Introduction: (Duration: 05 Minutes)</td></tr>
<tr><td></td><td></td><td colspan="2">Unit – I: Introduction to Big data (Duration: 90 Minutes)</td></tr>
<tr><td></td><td></td><td>Overview</td><td>In this unit you will learn about Big Data and understand why it's important</td></tr>
<tr><td></td><td></td><td>Learning objectives</td><td>After Completing this unit, you should be able to:
• Understand what Big Data is
• Develop an understanding of the complete open-source Hadoop ecosystem and its near-term future directions
• Understand the major challenges of data
• Understand how the growth of interconnected devices helps big data</td></tr>
</table>

			• List some real-life examples of Big Data • Learn the types of Big Data & Student some Big Data use cases
MODULE II – Prerequisites			
	This course does not have any prerequisites		
MODULE III – Big Data Engineer			
	Course I – Introduction to the Big Data Ecosystem (Duration: 19.5 Hours)		
		Course Introduction: (Duration: 05 Minutes)	
		Unit – I: Introduction to Big data (Duration: 30 Minutes)	
		Overview	In this unit you will learn about Big Data and understand why it's important
		Learning objectives	After Completing this unit, you should be able to: • Develop an understanding of the complete open-source Hadoop ecosystem and its near-term future directions. • Be able to compare and evaluate the major Hadoop distributions and their ecosystemcomponents, both their strengths and their limitations. • Gain hands-on experience with key components of various big data ecosystemcomponents and their roles in building a complete big data solution to common business problems. • Learning the tools that will enable you to continue your big data education after the course.
		Unit – 2: Introduction to Hortonworks Data Platform (HDP) - (Duration: 30 Minutes)	
		Overview	In this unit you will learn about the Hortonworks Data Platform (HDP).
		Learning objectives	After Completing this unit, you should be able to: • Describe the functions and features of HDP • List the IBM value-add components • Explain what IBM Watson Studio is • Give a brief description of the purpose of each of the value - add components
		Lab – 1: Exploration of the lab environment (Duration: 01 Hour)	
		Overview	In this lab, you will explore the lab environment. You will access your lab environment and launch Apache Ambari. You will startup a variety of services by using the Ambari GUI. You willalso explore some of the directory structure on the Linux system that you will be using.
		Learning objectives	After Completing this unit, you should be able to: • Explore the lab environment • Launch Apache Ambari • Start a variety of services using Apache GUI • Explore some of the directory structure on the Linux system
		Unit – 3: Apache Ambari (Duration: 30 Minutes)	
		Overview	In this section you will learn about Ambari, which is one of the operations tools that come withHDP
		Learning objectives	After Completing this unit, you should be able to: • Understand the purpose of Apache Ambari in the HDP stack • Understand the overall architecture of Ambari, and Ambari's relation to other services andcomponents of a Hadoop cluster • List the functions of the main components of Ambari • Explain how to start and stop services from Ambari Web Console

		Lab – 1: Managing Hadoop clusters with Apache Ambari (Duration: 01 Hour)	
		Overview	In this lab you will explore the Apache Ambari web console and perform basic starting andstopping of services, giving you experience in using Apache Ambari to manage your Hadoopcluster
		Learning objectives	After Completing this unit, you should be able to: • Manage Hadoop clusters with Apache Ambari ❖ Start the Apache Ambari web console and perform basic start/stop services ❖ Explore other aspects of the Ambari web server
		Unit – 4: Hadoop and HDFS (Duration: 01 Hour)	
		Overview	This unit will explain the underlying technologies that are important to solving the big data challenge
		Learning objectives	After Completing this unit, you should be able to: • Understand the basic need for a big data strategy in terms of parallel reading of large datafiles and internode network speed in a cluster • Describe the nature of the Hadoop Distributed File System (HDFS) • Explain the function of the Name Node and Data Nodes in an Hadoop cluster • Explain how files are stored and blocks ("splits") are replicated
		Lab – 1: File access and basic commands with HDFS (Duration: 01 Hour)	
		Overview	This lab is intended to provide you with experience in using the Hadoop Distributed File System(HDFS). The basic HDFS file system commands learned here will be used throughout the remainder of the course. You will also be moving some data into HDFS that will be used in later units of this course. The files that you will need are stored in the Linux directory / home / lab files
		Learning objectives	After Completing this unit, you should be able to: • File access and basic commands with HDFS
		Unit – 5: Map Reduce and YARN (Duration: 02 Hours)	
		Overview	In this unit you will learn about MapReduce and YARN
		Learning objectives	After Completing this unit, you should be able to: • Describe the MapReduce model v1 • List the limitations of Hadoop 1 and MapReduce 1 • Review the Java code required to handle the Mapper class, the • Reducer class, and the program driver needed to access MapReduce • Describe the YARN model • Compare Hadoop 2/YARN with Hadoop 1
		Lab – 1: Running MapReduce and YARN jobs (Duration: 01 Hour)	
		Overview	In this lab, you will run Java programs using Hadoop v2, YARN, and related technologies
		Learning objectives	After Completing this unit, you should be able to: • Run MapReduce and YARN jobs
		Lab – 2: Creating and coding a simple Map Reduce job (Duration: 01 Hour)	
		Overview	In this lab, you will compile and run a more complete version of Word

			Count that has beenwritten specifically for Map Reduce2
		Learning objectives	After Completing this unit, you should be able to: • Create and code a simple MapReduce job
		Unit – 6: Apache Spark (Duration: 02 Hours)	
		Overview	In this unit you will learn about Apache Spark.
		Learning objectives	After Completing this unit, you should be able to: • Understand the nature and purpose of Apache Spark in the Hadoop ecosystem • List and describe the architecture and components of the Spark unified stack • Describe the role of a Resilient Distributed Dataset (RDD) • Understand the principles of Spark programming • List and describe the Spark libraries • Launch and use Spark's Scala and Python shells
		Lab – 1: Working with a Spark RDD with Scala (Duration: 01 Hour)	
		Overview	In this lab, you will learn to use some of the fundamental aspects of running Spark in the HDP environment
		Learning objectives	After Completing this unit, you should be able to: • Work with Spark RDD with Scala
		Unit – 7: Storing and querying data (Duration: 02 Hours)	
		Overview	In this unit you will learn about storing and querying data
		Learning objectives	After Completing this unit, you should be able to: • List the characteristics of representative data file formats, including flat/text files, CSV,XML, JSON, and YAML • List the characteristics of the four types of NoSQL datastores • Describe and compare the open – source programming languages, Pig and Hive • Describe the storage used by HBase in some detail • List the characteristics of programming languages typically used by Data Scientists: R and Python
		Lab – 1: Using Hive to access Hadoop/HBase data (Duration: 30 Minutes)	
		Overview	In this lab, you will use Hive to access Hadoop/HBase data
		Learning objectives	After Completing this lab, you should be able to: • Use Hive to access Hadoop/HBase data
		Unit – 8: ZooKeeper, Slider, and Knox (Duration: 01 Hour)	
		Overview	In this unit you will learn about ZooKeeper, Slider and Knox
		Learning objectives	After Completing this unit, you should be able to: • Understand the challenges posed by distributed applications and how ZooKeeper isdesigned to handle them • Explain the role of ZooKeeper within the Apache Hadoop infrastructure and the realm ofBig Data management • Explore generic use cases and some real-world scenarios for ZooKeeper • Define the ZooKeeper services that are used to manage distributed systems

			• Explore and use the ZooKeeper CLI to interact with ZooKeeper services • Understand how Apache Slider works in conjunction with YARN to deploy distributedapplications and to monitor them • Explain how Apache Knox provides peripheral security services to an Hadoop cluster
		Lab – 1: Explore ZooKeeper (Duration: 30 Minutes)	
		Overview	In this lab, you will connect to ZooKeeper and explore the ZooKeeper files
		Learning objectives	After Completing this lab, you should be able to: • Connect to ZooKeeper and explore the ZooKeeper files
		Unit – 9: Loading data with Sqoop (Duration: 30 Minutes)	
		Overview	In this unit you will learn how to load data with Sqoop
		Learning objectives	After Completing this unit, you should be able to: • List some of the load scenarios that are applicable to Hadoop • Understand how to load data at rest • Understand how to load data in motion • Understand how to load data from common sources such as a data warehouse, relationaldatabase, web server, or database logs • Explain what Sqoop is and how it works • Describe how Sqoop can be used to import data from relational systems into Hadoop andexport data from Hadoop into relational systems • Brief introduction to what Flume is and how it works
		Lab – 1: Moving data into HDFS with Sqoop (Duration: 30 Minutes)	
		Overview	In this lab, you will learn how to move data into an HDFS cluster from a relational database
		Learning objectives	After Completing this lab, you should be able to: • Move data into HDFS with Sqoop
		Unit – 10: Security and Governance (Duration: 01 Hour)	
		Overview	In this unit you will learn about the need of data governance and the role of data security in it
		Learning objectives	After Completing this unit, you should be able to: • Explain the need for data governance and the role of data security in this governance • List the Five Pillars of security and how they are implemented with HDP • Discuss the history of security with Hadoop • Identify the need for and the methods used to secure Personal & Sensitive Information • Describe the function of the Hortonworks Data Plane Service (DPS)
		Unit – 11: Stream Computing (Duration: 01 Hour)	
		Overview	In this unit you will learn about stream computing
		Learning objectives	After Completing this unit, you should be able to: • Define streaming data • Describe IBM as a pioneer in streaming data - with System S □IBM Streams

			• Explain streaming data - concepts & terminology • Compare and contrast batch data vs streaming data • List and explain streaming components & Streaming Data Engines (SDEs)
	Course II – Introduction to Data Science (Duration: 1.75 Hours)		
		Course Introduction: (Duration: 05 Minutes)	
		Unit – 1: Data Science and Data Science Notebooks (Duration: 45 Minutes)	
		Overview	In this unit, you will learn about data science and data science notebooks
		Learning objectives	After Completing this unit, you should be able to: • Have a better understanding of methodology “scientific approach” methods used & skillspracticed by Data Scientists • Recognize the iterative nature of a data science project • Outline the benefits of using Data Science Notebooks • Describe the mechanisms and tools used with Data Science Notebooks • Compare and contrast the major Notebooks used by Data Scientists
		Unit – 2: Data Science with Open - Source Tools (Duration: 30 Minutes)	
		Overview	In this unit, we will concentrate on the Jupyter Notebook and Python
		Learning objectives	After Completing this unit, you should be able to: • Getting started with Jupyter Notebook • Data and notebooks in Jupyter • How notebooks help data scientists • Essential packages: NumPy, SciPy, Pandas, Scikit-learn, NLTK, Beautiful Soup, … • Data visualizations: matplotlib, …, Pixie Dust • Using Jupyter “Magic” commands
		Lab – 1: Introduction to Jupyter Notebooks (Duration: 30 Minutes)	
		Overview	In this lab you will be introduced to Jupyter Notebooks

		Learning objectives	After Completing this experiment, you should be able to:
			• Start Jupyter - it will open in a web browser
			• Import the lab file (all Jupyter files have a .ipynb suffix) into your default workspace
			  o This is now a copy of the provided lab file and you can do anything with it
			  o If you mess it up, you can re-import again later
			• Explore the component panels - some are markdown, some are code, some are results ofrunning the code (output data, visualizations, …)
			• Learn how to run single panels - and then the whole script
			  o You may need to adjust the provided script to locate the data files that accompany the Jupyter. ipynb file
			  o Add some additional panels, as described in the lab script

	Course III – Big SQL (Duration: 7.25 Hours)		
		Course Introduction: (Duration: 05 Minutes)	
		Unit – 1: Using Big SQL to access data residing in the HDFS (Duration: 40 Minutes)	
		Overview	In this unit, you will learn about Big SQL, and how to use it to access data residing in the HDFS

		Learning objectives	After Completing this unit, you should be able to: • Overview of Big SQL • Understand how Big SQL fits in the Hadoop architecture • Start and stop Big SQL using Ambari and command line • Connect to Big SQL using command line • Connect to Big SQL using IBM Data Server Manager
		Lab – 1: Connecting to the IBM Big SQL Server (Duration: 30 Minutes)	
		Overview	In this lab you will connect to the Big SQL Server using multiple techniques. You will first explorethe lab environment. You will then learn how to set up JSqsh and use it to connect to the Big SQL server. You will also explore the Big SQL service using the Data Server Manager (DSM) graphical web interface
		Learning objectives	After Completing this exercise, you should be able to: • Configure images • Start Hadoop components • Start up the Big SQL and DSM services • Connect to Big SQL using JSqsh • Execute basic Big SQL statements • Explore Big SQL through Ambari using DSM
		Unit – 2: Creating Big SQL schemas and tables (Duration: 55 Minutes)	
		Overview	In this unit, you will learn how to create Big SQL schemas and tables
		Learning objectives	After Completing this unit, you should be able to: • Describe and create Big SQL schemas and tables • Describe and list the Big SQL data types • Work with various Big SQL DDLs • Load data into Big SQL tables using best practices
		Lab – 1: Creating and managing Big SQL schemas and tables (Duration: 35 Minutes)	
		Overview	In this lab you will start off by creating and dropping a simple Big SQL table. You then will createmultiple Big SQL tables using a variety of data types and load the tables with data. You will also work with views, external tables, and other methods of creating Big SQL tables
		Learning objectives	After Completing this exercise, you should be able to: • Create and drop simple Big SQL table • Create sample tables • Move data into HDFS • Load data into Big SQL tables • Create and work with views • Create external tables
		Unit – 3: File formats and querying Big SQL tables (Duration: 01 Hour)	
		Overview	In this unit, you will learn about file formats and querying Big SQL tables
		Learning objectives	After Completing this unit, you should be able to: • Describe Big SQL supported file formats • Query Big SQL tables using various DMLs

		Lab – 1: Querying Big SQL tables (Duration: 30 Minutes)	
		Overview	In this lab you will experiment with some more advanced SQL queries. You will then explore BigSQL's ARRAY type. You will also create a user-defined function (UDF) and write queries that callthe UDF. Finally, you will store data in an alternate file format (Parquet).
		Learning objectives	After Completing this exercise, you should be able to: • Connect to Big SQL • Query data with Big SQL • Work with the ARRAY type • Work with Big SQL functions • Store data in an alternate file format (Parquet)
		Unit – 4: Configuring Big SQL security (Duration: 01 Hour)	
		Overview	In this unit, you will learn about how to configure Big SQL security
		Learning objectives	After Completing this unit, you should be able to: • Configure authentication for Big SQL • Manage security with Apache Ranger • Enable SSL encryption • Configure authorization of Big SQL objects • Configure impersonation in Big SQL
		Lab – 1: Configuring Big SQL Security (Duration: 30 Minutes)	
		Overview	In this lab you will work with Big SQL authorization techniques
		Learning objectives	After Completing this lab, you should be able to: • Use column masking and row - based access control to restrict access to your data
		Lab – 2: Configuring impersonation in Big SQL (Duration: 30 Minutes)	
		Overview	In this lab you will enable and configure impersonation with Big SQL
		Learning objectives	After Completing this lab, you should be able to: • Configure impersonation in Big SQL
		Unit – 5: Data federation with Big SQL (Duration: 45 Minutes)	
		Overview	In this unit, you will learn data federation with Big SQL
		Learning objectives	After Completing this unit, you should be able to: • Understand the concept of Big SQL federation • List the supported data sources • Set up and configure a federation server to use different data sources
		Lab – 1: Using Fluid Query with Big SQL (Duration: 15 Minutes)	
		Overview	In this lab you will configure Fluid Query with Big SQL
		Learning objectives	After Completing this lab, you should be able to: • Configure Fluid Query with Big SQL
	Course IV – IBM Watson Studio (Duration: 2.60 Hours)		
		Course Introduction: (Duration: 05 Minutes)	
		Unit – 1: Introduction to IBM Watson Studio (Duration: 30 Minutes)	
		Overview	In this unit, you will learn about Watson Studio
		Learning objectives	After Completing this unit, you should be able to: • What is Watson Studio? • Setting up a project & Working with collaborators

			• Managing data assets
		Lab – 1: Getting started with Watson Studio (Duration: 01 Hour)	
		Overview	In this lab, you will create and manage a project, add collaborators, and load a data set to theobject store
		Learning objectives	After Completing this lab, you should be able to: • Sign up for a Watson Studio account • Create a new project • Manage a project • Add collaborators • Load data • Manage the object storage
		Unit – 2: Analyzing data with Watson Studio (Duration: 30 Minutes)	
		Overview	In this unit, you will learn how to analyze data with Watson Studio.
		Learning objectives	After Completing this unit, you should be able to: • Overview of Jupyter notebooks • Creating notebooks • Coding and running notebooks • Sharing and publishing notebooks
		Lab – 1: Analyzing data with Watson Studio (Duration: 30 Minutes)	
		Overview	In this lab, you will run through a sample notebook in Watson Studio and use Pixie Dust for data visualization
		Learning objectives	After Completing this lab, you should be able to: • Create a notebook • Use notebooks • Work with external data

Course Title	**Computer Networks (Professional Elective Course-I)**			**B.Tech. V Sem (R20UG) AI&ML**
Course Code	**Category**	**Hours / Week**	**Credits**	**Maximum Marks**

<table>
<tr><td rowspan="2">2039504</td><td rowspan="2">PEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3 Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
• Study the evolution of computer networks and future direction.
• Study the concepts of computer networks from layered.
• Perspective study the issues open for research in computer networks.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO1</td><td colspan="8">Understand the terminology and concepts of the OSI reference model and TCP-IP.</td></tr>
<tr><td>CO2</td><td colspan="8">Describe the functions of Data link layer and its protocols.</td></tr>
<tr><td>CO3</td><td colspan="8">Classifying the different routing algorithms and IP addressing with network layer</td></tr>
<tr><td>CO4</td><td colspan="8">Understand connection establishment and services provides by TCP and UDP.</td></tr>
<tr><td>CO5</td><td colspan="8">Explain the working of DNS and World Wide Web.</td></tr>
</table>

UNIT - I

Introduction: Uses of Computer Networks, Network Hardware, Reference Models: OSI, TCP/IP, Comparison of OSI & TCP/IP reference models.

Introduction to physical layer: Data and Signals, Transmission impairment, Data rate limits,Performance.

Transmission media: Introduction, Guided Media, Unguided Media.

Switching: Introduction, Circuit Switched Networks, Packet Switching.

UNIT - II

The Data Link Layer: Data Link Layer design issues, Error Detection and Correction,Elementary Data Link Protocols, Sliding Window Protocols.

The Medium Access Control sublayer : Multiple Access protocols, Ethernet, Data Link Layer Switching.

UNIT - III

The Network Layer: Network layer design issues, Routing algorithms: The Optimality Principle, Shortest Path Algorithm, Flooding, Distance Vector Routing, Link State Routing,Hierarchical Routing, Broadcast Routing, Multicast Routing, Anycast Routing, Congestion control algorithms, Quality of service, IP Addresses, IPv4, IPv6, Tunneling, Fragmentation.

UNIT - IV

The Transport Layer: The Transport Service, Elements of Transport Protocols, Congestion Control, the internet transport protocols: UDP, TCP: Introduction to TCP, Service Model, Protocol, Segment Header, Connection Establishment, Connection Release.

UNIT - V

The Application layer: Domain Name System (DNS), World Wide Web (WWW), E- mail.

Text Books:

1. “Computer Networks”, Andrew S. Tanenbaum, David J.Wetherall, Pearson, 5th edition, 2010.
2. “Data communications and networking”, Behrouz A. Forouzan, TMH, 5th edition, 2012.
3. “Internetworking with TCP/IP – Principles, protocols, and architecture- Volume 1, Douglas E. Comer, 5th edition, PHI
4. “Computer Networks”, 5E, Peterson, Davie, Elsevier.

Reference Books:

1. “Introduction to Computer Networks and Cyber Security”, Chawan- Hwa Wu, Irwin, CRC Publications.
2. “Computer Networks and Internets with Internet Applications”, Comer.
3. Computer Networks, A Top-Down Approach, James F. Kurose, Keith W. Ross, 3rd Edition, Pearson.
4. Computer Networks, A Top-Down Approach, Behrouz A. Forouzan, Firoz Mosharraf,Special Indian Edition, McGraw Hill.

Course Title	Image Processing (Professional Elective Course – I)					B.Tech. V Sem (R20UG) AI&ML		
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
2039505	PEC	L	T	P	C	ContinuousInternal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 90 Minutes						**End Exam Duration: 3Hrs**		

Course Objectives:

- Acquire the basic knowledge on fundamentals of digital images.
- Learn about image enhancement in spatial domain, image filtering and color image processing.
- Understand various image segmentation and image coding schemes.
- Learn image transform to analyze and modify image.
- Learn concepts of degradation function and restoration techniques.

Course Outcomes: On successful completion of this course, the students will be able to

CO1	Understand the concepts of image processing system and various operations that can perform on digital images.
CO2	Understand the image enhancement in spatial and frequency domain.
CO3	Understand various image restoration techniques.
CO4	Understand various image compression and segmentation techniques.
CO5	Understand the various mathematical transforms, color image concepts and processing.

UNIT – I

Basic Concepts Definition, Applications of Digital Image Processing, Fundamental Steps, Components of Image Processing System, Human Visual System, Simple Image Formation Model, Image Sampling and Quantization, Spatial and Gray Level Resolution, Image Interpolation, Some Basic Relationships Between Pixels, Linear And Non Linear Operations.

UNIT – II

Spatial Domain: Basic Gray Level Transformations, Histogram Processing, Enhancement Using Logical And Arithmetic Operations, Image Subtraction, Image Averaging, Basic of Spatial Filtering, Smoothing And Sharpening Spatial Filters, Combining Spatial Enhancement Methods.

Frequency Domain: Introduction to Fourier Transforms, Basics of Filtering in Frequency Domain, Fundamental Steps in Filtering in Frequency Domain, Smoothing Frequency Domain Filters, Sharpening Frequency Domain Filters, Homomorphic Filtering.

UNIT – III

Image Restoration Model of Image Degradation/Restoration Model, Noise Models, Restoration In Presence of Noise Only-Spatial Filtering, Adaptive Filters, Periodic Noise Reduction by Frequency Domain Filtering, Linear Position Invariant Derivations, Algebraic Approach to Restoration, Inverse Filtering, Least Mean Square Filters, Constrained Least Squares Restoration.

UNIT-IV

Image Compression: File format (bmp, tiff, pcx, gif, jpeg.), Compression fundamentals, Image Compression Models, Error Free Compression: VLC, Arithmetic Coding, LZW coding, Bit plane Coding, Lossless Predictive Coding, Lossy Compression: Lossy Predictive Coding, Block Transform coding.

Image Segmentation: Fundamentals, Detection of Discontinuities: Point, Line, Edge detection, Edge Linking and Boundary Detection: Local Processing, Global Processing via Hough Transform.

UNIT – V

Image Transforms: Introduction One- and Two-Dimensional Discrete Fourier Transform (DFT), Properties of DFT, Properties of Discrete cosine and sine transforms, Properties of Slant, KL transforms.

Color Image Processing: Color fundamentals, Color models: RGB, CMY and CMYK, HSI, Converting colors, RGB to HIS, HIS to RGB manipulating HIS component images, Pseudo color Image Processing, Full Color Image Processing.

Text Books:

1. Rafael Gonzalez & Richard Woods, ―Digital Image Processing‖, 3rd Edition. Pearson publications, 2012
2. Anil K. Jain, ―Fundamental of Digital Image Processing‖, PHI publication, 2013.
3. S. Jayaraman, S. Esakkirajan & T. Veera Kumar, ―Digital Image Processing‖, Mc. Graw Hill, 2011.

Reference Books:

1. Pratt, ―Digital Image Processing‖, 2nd Edition, Wiley Publication, 1991.
2. S. Sridhar, ―Digital Image Processing‖, Oxford University Press, 2011.

Web References:

1. https://nptel.ac.in/courses/117105079/
2. https://nptel.ac.in/courses/117104069/
3. https://nptel.ac.in/courses/106105032/

<table>
<tr><td>Course Title</td><td colspan="3">Web Technologies
(Professional Elective Course – I)</td><td colspan="3">B.Tech. V Sem (R20UG) AI&ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039506</td><td rowspan="2">PEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- Familiarize the tags of HTML.
- Write backend code in PHP language and Writing optimized front end code HTML and JavaScript.
- Understand, create and debug database related queries and Create test code to validate the applications against client requirement.

Course Outcomes: On successful completion of this course, the students will be able to

CO1	Enumerate the Basic Concepts of Markup Languages.
CO2	Develop web Applications using Scripting Languages & Frameworks.
CO3	Make use of Express JS frameworks.
CO4	Develop server side programs using PHP.
CO5	Accessing database through PHP.

UNIT - I

HTML: Basic Syntax, Standard HTML Document Structure, Basic Text Markup, Html styles, Elements, Attributes, Heading, Layouts, Html media, Iframes Images, Hypertext Links, Lists, Tables, Forms, GET and POST method, HTML 5, Dynamic HTML.

CSS: Cascading style sheets, Levels of Style Sheets, Style Specification Formats,

UNIT - II

JavaScript: Introduction to JavaScript, Objects, Primitives Operations and Expressions, Control Statements, Arrays, Functions, Constructors, Pattern Matching using Regular Expressions,

UNIT - III

Fundamentals of Angular JS and NODE JS Angular Java Script- Introduction to Angular JS. **Expressions:** ARRAY, Objects, Strings, Angular JS Form Validation & Form Submission.

UNIT - IV

PHP Programming: Introduction to PHP, Creating PHP script, Running PHP script. Working with variables and constants: Using variables, Using constants, Data types, Operators. Controlling program flow: Conditional statements, Control statements, Arrays, functions. PHP Advanced Concepts: Using Cookies, Using HTTP Headers, Using Sessions, Authenticating users.

UNIT - V

Database connectivity – Basic Database Concepts, Connecting to a MYSQL database, JSP, PHP, Practice of SQL Queries. Introduction to Mongo DB and JQuery.

Text Books:

1. Programming the World Wide Web, 7th Edition, Robet W Sebesta, Pearson, 2013.
2. Web Technologies, 1st Edition 7th impression, Uttam K Roy, Oxford, 2012.
3. Pro Mean Stack Development, 1st Edition, ELad Elrom, Apress O'Reilly, 2016
4. Java Script & jQuery the missing manual, 2nd Edition, David sawyer mcfarland, O'Reilly,2011.
5. Beginning PHP and MySQL, 5th Edition, Jason Gilmore, A press Publications (Dreamtech.)

Reference Books:

1. Ruby on Rails Up and Running, Lightning fast Web development, 1st Edition, BruceTate, Curt Hibbs, Oreilly, 2006.
2. Programming Perl, 4th Edition, Tom Christiansen, Jonathan Orwant, O'Reilly, 2012.
3. Web Technologies, HTML, JavaScript, PHP, Java, JSP, XML and AJAX, Black book, 1st Edition, Dream Tech, 2009.

<table>
<tr><td>Course Title</td><td colspan="5">Disaster Management</td><td colspan="3">B.Tech CE V Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE101</td><td rowspan="2">Open Elective (OEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 1.5 Hrs</td><td colspan="3">End Exam Duration: 3 Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
To make the student to provide basic conceptual understanding of disasters and its relationships with planning management.
To make the student to gain an understanding of the scope and extent to which natural and manmade disasters influence vulnerability profile of India.
To make the student able to relate disasters impact on social, economic and political environment.
To make the students to understand approaches of Disaster Risk Reduction and the relationship between vulnerability, disasters, disaster prevention and risk reduction.
To make the student able to enhance awareness of Disaster Risk Management and build skills to respond at disasters.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
</table>

CO 1	Define and describe the terminology used within disaster planning and Management.
CO 2	Understand the scope, extent, and complexity of natural and man-made disasters.
CO 3	Justify the knowledge gained from disaster impacts on health, psycho-social issues and demographic aspects
CO 4	Discuss effective means to plan, mitigate, respond, and recover from disasters and emergencies, natural and man-made
CO 5	Understand the problems associated with government collaboration and assistance to state and local governments and non-governmental organizations.

UNIT-I
Introduction
Concepts and definitions: disaster, hazard, vulnerability, risks severity, frequency and details, capacity, impact, prevention, mitigation.

UNIT – II
Disasters
Disasters classification; natural disasters: floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.; manmade disasters: industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.; hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

UNIT – III
Disaster Impacts
Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

UNIT – IV
Disaster Risk Reduction (DRR)
Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems,

Post-disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); sustainable and environmental friendly recovery; reconstruction and development methods.

UNIT – V

Environment and Development

Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Text Books:

1. Pradeep Sahni and Madhavi Ariyabandu, "Disaster Risk Reduction in South Asia", PHI Learning Pvt. Ltd., Delhi.
2. B. K. Singh, "Handbook of Disaster Management: Techniques and Guidelines", Rajat Publications, Delhi.
3. Inter-Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC.
4. Inter-Agency Standing Committee (IASC) (Feb. 2007) IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC

Reference Books:

1. G. K. Ghosh, "Disaster Management", APH Publishing Corporation, New Delhi.
2. http://ndma.gov.in/ (Home page of National Disaster Management Authority.
3. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
4. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003.

<table>
<tr><td>Course Title</td><td colspan="5">Basics of Civil Engineering</td><td colspan="3">B.Tech CE V Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE102</td><td rowspan="2">Open Elective (OEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 1.5 Hrs</td><td colspan="3">End Exam Duration: 3 Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
To include the essentials of civil engineering field to the students of all branches of Engineering
To provide the students an illustration of the significance of the civil engineering profession in satisfying social needs.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
</table>

CO 1	Illustrate the fundamental aspects of Civil Engineering.
CO 2	List the components of various types of buildings.
CO 3	Explain the concepts of planning and able to read a building plan.
CO 4	Illustrate the setting out of a building and acquire knowledge on building area items.
CO 5	Discuss about various building materials used for construction.

UNIT-I

General introduction to Civil Engineering

Various disciplines of civil engineering, Relevance of civil engineering in the overall infrastructural development of the country. Introduction to types of buildings as per NBC, selection of sites for buildings.

UNIT – II

Building Components

Components of residential buildings and their functions; Introduction to industrial buildings – office/factory/software development office/power house/electronic equipment service centre.

UNIT – III

Building planning

Introduction to planning of residential buildings- site plan, orientation of a building, open space requirement, position of doors and windows, size of rooms; preparation of a scaled sketch of the plan of a single storeyed residential building in a given site plan.

UNIT – IV

Building area items

Introduction to the various building area items – computation of plinth area / built up area, floor area / carpet area – for a single storeyed building; setting out of a building.

UNIT – V

Building construction

Foundations; Bearing capacity of soil (definition only) - Functions of foundations, Types - shallow and deep (sketches only)

Brick masonry – header and stretcher bond, English bonds – Elevation and Plan (one brick thick walls only)

Roofs – functions, types, roofing materials

Floors – functions, types; flooring materials

Paints and Painting – Purpose, types

Text Books:

1. Gopi, S., "Basic Civil Engineering", Pearson Publishers

2. S.S Bhavikatti, “Basics civil engineering”, New international publishers
3. Rangwala, S.C and Dalal, K. B., “Building Construction”, Charotar Publishing house
4. Rangwala, S.C., “Essentials of Civil Engineering”, Charotar Publishing

Reference Books:

1. Mckay, W.B. and McKay, J. K., “Building Construction Volumes 1 to 4”, Person India Education Services
2. Minu, S., “Basic Civil Engineering”, Karunya Publication
3. Chudley, R., “Construction Technology, Vol. I to IV”, Longman Group, England
4. Kandya, A. A., “Elements of Civil Engineering”, Charotar Publishing house.

<table>
<tr><td>Course Title</td><td colspan="5">Building Materials</td><td colspan="3">B.Tech CE V Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE103</td><td rowspan="2">Open Elective (OEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 1.5 Hrs</td><td colspan="3">End Exam Duration: 3 Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
The importance and fundamental knowledge of building materials such as stones and aggregates its properties for better construction.
The laboratory, field tests conducted on Bricks and Cement to identify better construction materials with strength & durability.
The ability to understand the properties of Lime and Timber.
Understand various Masonry works used in the construction field.
To study the Modern Engineering materials used in construction.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
</table>

CO 1	Aware of natural and manufactured aggregates and the importance of physical properties of aggregates used for building construction.
CO 2	Identify various properties of bricks and steel used in construction of structures.
CO 3	Select appropriate timber and cement materials for different types of constructions.
CO 4	Choose suitable masonry works for modern construction to enhance the elegance and performance.
CO 5	Aware of different modern materials in construction.

UNIT-I

Stones and Aggregates

Properties of building stones – Classification of stones – Stone quarrying, precautions in blasting – Dressing of stone, Fine aggregate: Natural and manufactured – Sieve analysis – Different tests on fine aggregate, Coarse aggregate: Natural and manufactured – Importance of size, shape and texture.

UNIT – II

Bricks

Composition – Types of bricks – Manufacturing process of bricks – Test on bricks – Standard requirements and grades.

Steel

Types and grades of steel, tests on steel, applications.

UNIT – III

Cement

Introduction – Chemical Composition – Types of cement with their specific uses – Grade of cement as per BIS – Engineering properties of cement – Field and Laboratory test of cement as per BIS.

Timber

Types of timber – Uses and application of timber – Defects in timber and wood – Seasoning Wood – Wood products with specific uses

UNIT – IV

Masonry Works

Masonry - Stone Masonry - Rubble Masonry - Brick Masonry - Bond - Types of bonds - English and Flemish bonds - Composite masonry - Concrete Masonry - Reinforced masonry - Types of walls - Types of Partition walls.

UNIT – V

Modern Building Materials

Aluminum – Fiber Reinforced Polymers – Ferro cement – Composite materials – Light Weight Roofing Materials – GI Sheets – Ceramics – Other Modern Materials.

Text Books:

1. Rajput R.K. "Engineering Materials", S. Chand & Company Ltd. New Delhi, Third Edition2009.
2. P C Varghese, "Building Materials", PHI Learning Pvt. Ltd., Delhi.
3. G C Sahu, Joygopal Jena, "Building Materials and Construction", McGraw hill Pvt Ltd 2015.
4. Arthur Lyons De, "Materials for Architects and Builders", Montfort University, Leicester, UK.

Reference Books:

1. S C Rangwala, "Engineering Materials", Charotar Publishing House Pvt. Ltd., Anand, Gujarat.
2. S K Duggal, "Building Materials", New Age International (P) Limited, Publishers, New Delhi.
3. S. C. Rangwala, "Building Construction", Charotar Publishing House Pvt. Ltd., Anand, Gujarat.
4. R. Chubby, "Construction Technology – Vol – I & II", Longman UK

<table>
<tr><td>Course Title</td><td colspan="4">Modern Control Theory</td><td colspan="3">B. Tech. EEE
Open Elective - 1</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE201</td><td rowspan="2">Open Elective (OEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 1Hr30M</td><td colspan="3">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: Students are able to learn the State Space, Describing function, phase plane and stability analysis including controllability and observability.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the concept of State Space Techniques</td></tr>
<tr><td>CO 2</td><td colspan="8">Analyze the stability of linear and nonlinear Systems</td></tr>
<tr><td>CO 3</td><td colspan="8">Construct the state model of Linear Time Invariant systems and Lyapunov functions for nonlinear systems</td></tr>
<tr><td>CO 4</td><td colspan="8">Determine Eigen values state transition matrix and examine the controllability and observability of linear time invariant systems</td></tr>
<tr><td>CO 5</td><td colspan="8">Design state feedback controller and observer</td></tr>
</table>

UNIT – I

State variable descriptions: Concepts of state, state variables, state vector, state space model, representation in state variable form, phase variable representation.

UNIT – II

Solution of State Equations: diagonalization –state transition matrix – properties - .solution of state equations of homogeneous and non-homogeneous systems.

UNIT – III

Controllability and Observability: Definition of controllability – controllability tests for continuous linear time invariant systems – Definition of observability – observability tests for continuous linear time invariant systems,

UNIT – IV

Design of Control Systems: Introduction, Pole placement by state feedback, Full order and reduced order observers,

UNIT – V

Stability: Introduction, equilibrium points – stability concepts and definitions – stability in the sense of Lyapunov - stability of linear system – methods of constructing Lyapunov functions For non-linear system : Krasovskii's method – Variable gradient method.

Text Books

1. Modern Control System Theory by M. Gopal, New Age International Publishers, 2nd edition, 1996.
2. Control System Engineering by I. J. Nagarath and M. Gopal, New Age International (P) Ltd.

Reference Books

1. Modern Control Engineering by K. Ogata, Prentice Hall of India, 3rd Edition, 1998.
2. Systems and Control by Stainslaw, H. Zak, Oxford Press, 2003.
3. Digital Control and State Variable Methods by M. Gopal, TMH, 1997.

<table>
<tr><td>Course Title</td><td colspan="4">Programming Fundamentals for Numerical Computations</td><td colspan="3">B. Tech. EEE
Open Elective - I</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE202</td><td rowspan="2">Open Elective (OEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 1Hr30M</td><td colspan="3">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The main objective of the course is to make the students familiar with scripts, functions, control flow and plotting and use them to solve various engineering problems.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand basic features, arrays and symbolic algebra.</td></tr>
<tr><td>CO 2</td><td colspan="8">Analyze various control flow structures, interpolation and curve fitting</td></tr>
<tr><td>CO 3</td><td colspan="8">Solve linear equations, Polynomials</td></tr>
<tr><td>CO 4</td><td colspan="8">Plot two-dimensional and three-dimensional graphics</td></tr>
</table>

UNIT-I

Basics Fundamental Features: Basic features, script M-files, code cells, arrays creation, addressing and array operations; multi-dimensional arrays.

UNIT-II

Control Flow: Arithmetic & Logical operators, control flow - if, if-else, for, while, switch case constructions and functions.

UNIT-III

Mathematical Operations: Matrix algebra and solutions to systems of linear equations, polynomials, Numerical integration, numerical differentiation

UNIT-IV

Graphics & Numerical techniques: Two-dimensional graphics, basics of three-dimensional graphics, interpolation, curve fitting.

UNIT-V

Symbolic Mathematics: Symbolic algebra, equation solving, differentiation and integration.

Text Books

1. Hanselman and Littlefield, "Mastering MATLAB 7", Pearson Education Etter,
2. Kuncickly, Hull, "Introduction to MATLAB 6", Pearson Education.

Course Title	Introduction to Hybrid and Electrical Vehicles					B.Tech ME V Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
20OE301	OEC-I	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 90 Minutes					End Exam Duration: 3Hrs			

Course Objectives:

. The objectives of this course are to

- Provide good foundation on hybrid and electrical vehicles.
- To address the underlying concepts and methods behind power transmission in hybrid and electrical vehicles.
- Familiarize energy storage systems for electrical and hybrid transportation.
- To design and develop basic schemes of electric vehicles and hybrid electric vehicles.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Use working of hybrid and electric vehicles.
CO 2	Choose a suitable drive scheme for developing an hybrid and electric vehicles depending on resources.
CO 3	Develop the electric propulsion UNIT and its control for application of electric vehicles
CO 4	Choose proper energy storage systems for vehicle applications.
CO 5	Design and develop basic schemes of electric vehicles and hybrid electric vehicles.

UNIT – I

Electric Vehicle Propulsion And Energy Sources

Introduction to electric vehicles, vehicle mechanics - kinetics and dynamics, roadway fundamentals propulsion system design - force velocity characteristics, calculation of tractive power and energy required, electric vehicle power source - battery capacity, state of charge and discharge , specific energy, specific power, Ragone plot. battery modeling - run time battery model, first principle model, battery management system- soc measurement, battery cell balancing. Traction batteries - nickel metal hydride battery, Li-Ion, Lipolymer battery.

UNIT – II

Electric Vehicle Power Plant And Drives

Introduction electric vehicle power plants. Induction machines, permanent magnet machines, switch reluctance machines. Power electronic converters-DC/DC converters - buck boost converter, isolated DC/DC converter. Two quadrant chopper and switching modes. AC drives- PWM, current control method. Switch reluctance machine drives - voltage control, current control.

UNIT – III

Hybrid And Electric Drive Trains

Introduction hybrid electric vehicles, history and social importance, impact of modern drive trains in energy supplies.Hybrid traction and electric traction. Hybrid and electric drive train topologies.

Power flow control and energy efficiency analysis, configuration and control of DC motor drives and induction motor drives, permanent magnet motor drives, switch reluctance motor drives, drive system efficiency.

UNIT - IV

Electric And Hybrid Vehicles - Case Studies

Parallel hybrid, series hybrid -charge sustaining, charge depleting.Hybrid vehicle case study – Toyota Prius, Honda Insight, Chevrolet Volt. 42 V system for traction applications. Lightly hybridized vehicles and low voltage systems. Electric vehicle case study - GM EV1, Nissan Leaf, Mitsubishi Miev.Hybrid electric heavy duty vehicles, fuel cell heavy duty vehicles.

UNIT – V

Electric And Hybrid Vehicle Design

Introduction to hybrid vehicle design.Matching the electric machine and the internal combustion engine. Sizing of propulsion motor, power electronics, drive system. Selection of energy storage technology, communications, supporting subsystem.Energy management strategies in hybrid and electric vehicles - energy management strategies- classification, comparison, implementation.

Text Books:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, 2/e, CRC Press, 2003.
2. Amir Khajepour, M. Saber Fallah, AvestaGoodarzi, Electric and Hybrid Vehicles: Technologies, Modeling and Control - A Mechatronic Approach, illustrated edition, John Wiley & Sons, 2014.
3. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.

Reference Books:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
2. John G. Hayes, G. AbasGoodarzi, Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, 1/e, Wiley-Blackwell, 2018

<table>
<tr><td>Course Title</td><td colspan="5">Rapid Prototyping</td><td colspan="3">B. Tech. ME V Sem</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE302</td><td rowspan="2">OEC-I</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
. The objectives of this course are to
● Familiarize techniques for processing of CAD models for rapid prototyping.
● Explain fundamentals of rapid prototyping techniques.
● Demonstrate appropriate tooling for rapid prototyping process.
● Focus Rapid prototyping techniques for reverse engineering.
Train Various Pre – Processing, Processing and Post Processing errors in RP Processes</td></tr>
</table>

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	Use techniques for processing of CAD models for rapid prototyping.
CO 2	Implement fundamentals of rapid prototyping techniques.
CO 3	Choose appropriate tooling for rapid prototyping process.
CO 4	Create rapid prototyping techniques for reverse engineering.
CO 5	Identify Various Pre – Processing, Processing and Post Processing errors in RP processes.

UNIT - I

Introduction to RP Introduction

Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC, other related technologies, Classification of RP.

RP Software: Need for RP software, MIMICS, Magics, SurgiGuide, 3-matic, 3D-Doctor, Simplant, Velocity2, VoXim, SolidView, 3DView, etc., software, Preparation of CAD models, Problems with STL files, STL file manipulation, RP data formats: SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP.

UNIT - II

Solid and Liquid Based RP Systems

Solid and Liquid Based RP Systems: Stereolithography (SLA): Principle, Process, Materials, Advantages, Limitations and Applications. Solid Ground Curing (SGC): Principle, Process, Materials, Advantages, Limitations, Applications. Fusion Deposition Modeling (FDM): Principle, Process, Materials, Advantages, Limitations, Applications. Laminated Object Manufacturing (LOM): Principle, Process, Materials, Advantages, Limitations, Applications.

UNIT - III

Powder Based RP Systems **Powder Based RP Systems**

Principle and Process of Selective Laser Sintering (SLS), Advantages, Limitations and Applications of SLS, Principle and Process of Laser Engineered Net Shaping (LENS), Advantages, Limitations and Applications of LENS, Principle and Process of Electron Beam Melting (EBM), Advantages, Limitations and Applications of EBM.

Other RP Systems: Three Dimensional Printing (3DP): Principle, Process, Advantages, Limitations and Applications. Ballastic Particle Manufacturing (BPM): Principle, Process, Advantages, Limitations, Applications. Shape Deposition Manufacturing (SDM): Principle, Process, Advantages, Limitations, Applications.

UNIT - IV

Rapid Tooling

Rapid Tooling: Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods.

Reverse Engineering (RE): Meaning, Use, RE – The Generic Process, Phases of RE Scanning, Contact Scanners and Noncontact Scanners, Point Processing, Application Geometric Model, Development.

UNIT – V

Errors in RP Processes

Errors in RP Processes: Pre-processing, processing, post-processing errors, Part building errors in SLA, SLS, etc.

RP Applications: Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP.

Text Books:

1. Chee Kai Chua and Kah Fai Leong, "3D Printing and Additive Manufacturing Principles and Applications" Fifth Edition, World Scientific Publications, 2017.
2. Ian Gibson, David W Rosen, Brent Stucker, "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing", Springer, Second Edition, 2010.

Reference Books:

1. Frank W.Liou, "Rapid Prototyping & Engineering Applications", CRC Press, Taylor & Francis Group, 2011.

Course Title	**Design for Manufacturing and Assembly**					**B.Tech ME V Sem**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE303	**OEC-I**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**--**	**3**	**40**	**60**	**100**
Mid Exam Duration: 90 Minutes					**End Exam Duration: 3Hrs**			

Course Objectives:

. The objectives of this course are to

- Discuss various factors influencing the manufacturability of components and use of tolerance s in manufacturing
- Explain various considerations in casting, welding, forging and machining processes.
- Demonstrate on the design factors dependent on the assembly methods.
- Teach the principles and rules of design for assembly.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Apply the importance of Design for Manufacturing and Assembly.
CO 2	Examine the form design factors with the help of Case study.
CO 3	Evaluate how the factor of redesign affects the product life cycle.
CO 4	Make use of DFA methods proposed by Boothroyd and Dewhurst.
CO 5	Analyse the importance of Design for Manufacturing and Assembly.

UNIT - I

Introduction to DFM

Significance of design, qualities of a designer and Design factors, Systematic working plan, The engineering problem to be solved, The basic design, Factors influencing choice of materials and the factors influencing manufacturing Process Capability Mean, Median, Variance, Mode, Standard Deviation, Normal Distribution and Process capability metrics, Process Capability, Tolerances-symbols and definition, Tolerances relevant to manufacturing, assembly and material condition, Tolerance stack-effects on assembly with examples, Methods of eliminating tolerance stack with examples.

UNIT - II

Form Design-Casting and Welding

Influence of loading, Materials, Production methods on form design, Casting considerations, Grey iron castings, Steel castings, Aluminum Casting Requirements and rules for casting, Form design of pressure die castings, Welding considerations welding Processes, Requirements and rules for welding, Redesign of components for casting-pattern-mould- Parting Line, Redesign of components for welding, Case studies in form design-simple problems in form design

UNIT – III

Form Design-Forging and Machining

Forging considerations hammer forging drop forging, Requirements and rules for forging, Choice between casting, forging and welding, Machining considerations Drills, Milling-Keyways, Dwells and Dwelling

Procedure Countersunk Head screws Requirements and rules for Machining considerations and Reduction of machined areas Redesign of components for Forging, Redesign of components for Machining, Simplification by separation and Simplification by amalgamation, Case studies.

UNIT - IV

Introduction to DFA

DFA, Introduction, Distinction between assembly methods and processes, Factors Determining assembly methods and processes, Success and failure-Causes of failure, Product Design factors independent of methods and processes , Introduction-Number of operations in the product, Assembly Precedence, Standardization, Design factors dependent on Assembly methods , Introduction-Single Station Assembly Line Assembly, Hybrid Systems, Manual Assembly lines, Flexible Assembly lines, Design factors dependent on Assembly processes, Factors Influencing Production rate to Facility Ratio- Parts Presentation, Manual Assembly, Dedicated Assembly, Transportation, Separation and Orientation-Flexible Assembly, Gripping, Transferring, Part Insertion, Failures and Error Recovery.

UNIT - V

Design For Assembly Methods

Approaches to design for assembly and Introduction, Approaches based on design principles and rules, Example DFA method using Design Principles, DFA Systems employing Quantitative evaluation procedures, IPA Stuttgart Method, DFA Methods employing a Knowledge based approach, Knowledge representation Computer Aided DFA methods, Part model, Feature, Processing. Assembly measures like Qualitative and Quantitative measures, Boothroyd and Dewhurst DFA method. Redesign of a simple product , Small consumer product and Fastener solution redesign using symmetry, Case Studies Designing of a disposal valve, Design of a lever-arch file mechanism.

Text Books:

1. Harry Peck., “Design for Manufacture”, Pittman Publications, 1983.
2. Alan Redford and chal, “Design for Assembly-Principles and Procedures”, McGraw Hill International Europe, London, 1994.

Reference Books:

1. RobertMatousek, “Engineering Design A Systematic Approach”, Blackie &sons Ltd., 1963.
2. James G.Bralla, “Hand Book of Product design for Manufacturing”, McGraw Hill Co., 1986.
3. Swift, K.G., “Knowledge Based Design for Manufacture”, Kogan Page Ltd., 1987

<table>
<tr><td>Course Title</td><td colspan="4">Energy Systems in Engineering</td><td colspan="3">B.Tech ME V Sem</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE304</td><td rowspan="2">OEC-I</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:
. The students completing this course are expected:

- Familiarize the sources of energy, power plant economics and environmental aspects.
- Outline the working components of different power plant.
- Explain renewable energy sources; characteristics, working principle, classify types, layouts, and plant operations.
- Impart types of nuclear power plants, and outline working principle and advantages and hazards.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Describe working components of a steam power plant.
CO 2	Understand the various elements of hydroelectric power plant and their types.
CO 3	Illustrate the working mechanism of Nuclear and Gas turbine power plants.
CO 4	Summarize types of renewable energy sources and their working principle.
CO 5	Analize power plant economics, and environmental aspects.

UNIT – I

Introduction to different Sources of Energy.

STEAM POWER PLANT: Layout of Modern Steam Power Plant, working of different circuits-selection of site- Coal Storage- Classification of coal handling and Ash handling systems.

UNIT – II

HYDRO ELECTRIC POWER PLANT: Selection of Site for Hydro Electric Power Plant – Hydrological cycle – Hydrographs - flow duration curve - mass curve – classification of dams, spill ways and surge tanks.

HYDRO PROJECTS AND PLANT: Classification of Hydro Electric Power Plants – Typical layout – plant auxiliaries – plant operation - pumped storage plants.

UNIT – III

NUCLEAR POWER PLANT: Nuclear fuel – breeding and fertile materials – Nuclear reactor – reactor operation.

TYPES OF REACTORS: Pressurized Water Reactor, Boiling Water Reactor, Sodium-Graphite Reactor, Fast Breeder Reactor, Homogeneous Reactor and Gas Cooled Reactor - Radiation hazards and shielding –radioactive waste disposal.

GAS TURBINE POWER PLANT: Introduction – Plant Layout – Classification – Working of

Simple Gas Turbine Power Plant– Constant pressure and constant volume Gas Turbine Power Plants –Combination of GasTurbine Cycles.

UNIT- IV

POWER FROM NON-CONVENTIONAL SOURCES: Utilization of Solar- Collectors-Principle of Working, Wind Energy– types – HAWT, VAWT -Tidal Energy.

Direct energy conversion: Solar energy, Fuel cells, MHD generation.

UNIT – V

POWER PLANT ECONOMICS: Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor, utilization factor, Plant capacity factor and plant use factor - Types of loads -Load curve and load duration curve - general arrangement of power distribution

Different types of tariff for Electrical energy –Cost of generation and fixed cost, semi fixed cost, running cost, depreciation methods, and straight line methods Simple problems.

Text Books:

1. P.K. Nag, Power Plant Engineering, 3/e, TMH, 2013.
2. Arora and S. Domkundwar, A course in Power Plant Engineering, DhanpatRai& Co (P) Ltd, 2014

Reference Books:

1. Rajput, A Text Book of Power Plant Engineering, 4/e, Laxmi Publications, 2012.
2. Ramalingam, Power plant Engineering, Scietech Publishers, 2013
3. P.C. Sharma, Power Plant Engineering, S.K. Kataria Publications, 2012

<table>
<tr><td>Course Title</td><td colspan="4">Smart Materials</td><td colspan="3">B.Tech ME V Sem</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE305</td><td rowspan="2">OEC-I</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

. The objectives of this course are to

- Introduce the students with HBLS and LBHS smart materials.
- Expose the students in smart systems development and uses.
- Understand the working principle of smart actuators and smart sensors.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Analyse the role of smart materials in development of intelligent systems and adaptive structures.
CO 2	Compare polycrystalline and single crystal piezoelectric materials
CO 3	Identify the influence of stress on characteristic temperatures in SMA and EAP
CO4	Evaluate the role of smart materials in development of intelligent systems and adaptive structures.
CO 5	Develop of various sensors.

UNIT - I

Introduction to Smart Materials

Introduction to Smart Materials: What is Intelligence? Artificial intelligence Vs. embedded Intelligence, Definition of smart material, need for smart materials, classifications of smart systems, components of a smart systems, smart system applications, the role of Smart Materials in developing Intelligent Systems and Adaptive Structures.

UNIT - II

High bandwidth - Low strain generating (HBLS) Smart Materials

Piezoelectric Materials – constitutive relationship, electromechanical coupling coefficients, piezoelectric constants, piezoceramic materials, variation of coupling coefficients in hard and soft piezoceramics, polycrystalline vs single crystal piezoelectric materials, polyvinyldene fluoride, piezoelectric composites. Magnetostrictive Materials – constitutive relationship, magneto-mechanical coupling coefficients, Joule Effect, Villari Effect, Matteuci Effect, Wiedemann effect, Giant magnetostriction in Terfenol-D, Terfenol-D particulate composites, Galfenol and Metglas materials.

UNIT - III

Low bandwidth - High strain generating (LBHS) materials

Low bandwidth - High strain generating (LBHS) materials: Shape Memory Alloys (SMA) – Introduction, Phenomenology, Influence of stress on characteristic temperatures, Modelling of shape memory effect. Vibration control through shape memory alloys. Design considerations, multiplexing embedded NiTiNOL actuators. Electro-active Polymers (EAP)- Introduction, Phenomenology, Influence of stress on characteristic temperatures.

UNIT - IV

Smart actuators

Based on HBLS smart materials: Piezoelectric Actuators – Induced Strain actuation model, Unimorph and Bimorph Actuators, Actuators embedded in composite laminate, Impedance matching in actuator design, Feedback Control, Pulse Drive, Resonance Drive. Magnetostrictive Actuators – Magnetostrictive Mini Actuators, Thermal instabilities, Discretely distributed actuation, Manetostrictive Composites.

Based on LBHS Smart Materials - Shape Memory Alloy based actuators for Shape Control, Electro-active Polymers for Work-Volume Generation.

UNIT - V

Smart sensors:

Sensors based on HBLS Smart Materials - Piezoelectric Sensors Magnetostrictive Sensors Techniques of Self Sensing MEMS Sensors.

Sensors based on LBHS Smart Materials - EAP based sensors, SMA based encoders, Optical Fibre based Sensing.

Text Books:

1. M.V. Gandhi, B.D. Thompson" Smart Materials and Structures" Springer Science & Business Media, 31-May-1992.

Reference Books:

1. Brian Culshaw, Smart Structures and Materials, Artech House, 2000.
2. Gauenzi, P., Smart Structures, Wiley, 2009.

<table>
<tr><td>Course Title</td><td colspan="4">Overview of Microcontrollers</td><td colspan="4">Open Electives</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE401</td><td rowspan="2">OE</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>-</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90Min</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
To become familiar with 8051, MSP 430, PIC and ARM controllers.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the types of Microcontrollers.</td></tr>
<tr><td>CO 2</td><td colspan="8">Define various components and list out various features of microcontrollers.</td></tr>
<tr><td>CO 3</td><td colspan="8">Describe the various blocks of 8051, MSP 430, PIC and ARM microcontrollers</td></tr>
</table>

UNIT I

Introduction: Microcontrollers, Vonneumann Vs Harvard, CISC vs RISC, Types of Microcontrollers, Examples of Microcontrollers, Selection of a microcontroller, Microcontroller resources, Applications.

UNIT II

The 8051 Architecture: Introduction, architecture of 8051, pin diagram, internal RAM memory organization, Special Function Registers, external memory interfacing-ROM & RAM, stack, timers and interrupts.

UNIT III

MSP 430 Microcontroller: The Outside View—Pin-Out, The Inside View—Functional Block Diagram, Memory, Central Processing Unit, Memory-Mapped Input and Output, Clock Generator, Exceptions: Interrupts and Resets.

UNIT IV

PIC Microcontrollers: Overview and Features, Architecture Details of PIC 16C6X/7X, I/O Ports, Interrupts, Timer, ADC, Features of 16F8XX series.

UNIT V

ARM Architecture: RISC Design philosophy, ARM Design philosophy, Registers, Program Status Register, Instruction pipeline, Interrupts and vector table.

Text Books:

1. Raj Kamal, “Microcontrollers - Architecture, Programming, Interfacing and System Design”- Second Edition, Pearson, 2012.
2. John H Davis, “MSP 430 Microcontroller Basics”, Newnes publishers, 2008.
3. Andrew N.Sloss, Dominic Symes, Chris Wright “ARM System Developer’s Guide-Designing and Optimizing system software”, Elsevier, 2008.
4. Ajay V Deshmukh, “Microcontrollers: Theory and Applications”, TMH, 2005.

Reference Books:

1. Mazidi Muhammad Ali, Mazidi Janice Gillespie &McKinlayRolin D, *The 8051Microcontroller and Embedded Systems,* 2nd Edition, Pearson Education, 2008.
2. Design with PIC Microcontrollers – John B. Peatman, Pearson Education, 2005.

Course Title	**Industrial electronics**				**Open Electives**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
20OE402	**OE**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	-	--	3	40	60	100
Mid Exam Duration: 90Min					**End Exam Duration: 3Hrs**		

Course Objectives:
To understand working of semiconductor devices.
To gain the knowledge of AC to DC, AC to AC and DC to DC converters.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the basics of Power Electronics.
CO 2	Learn the details of power semiconductor switches (Construction, Characteristics and operation)
CO 3	Understand the working of various types of converters.
CO 4	Learn how to analyze the converters and design the components of them, under various load types.
CO 5	Learn about the control of various converters

Unit-I
Power Semiconductor devices: Constructional features, Operating Principle, Characteristics and specification of power semiconductor diode, Power Bipolar Junction transistor (BJT), Thyristors and Triacs, Gate Turn off Thyristors (GTO), Metal oxide semiconductor field effect transistor (MOSFET), Insulate Gate Bipolar transistor (IGBT), Hard and soft switching of Power semiconductors.

Unit-II
AC to DC Convertors: Single Phase uncontrolled rectifier, Single Phase fully controlled rectifier, single phase half controlled bridge rectifier, Operation and analysis of three phase fully controlled bridge converter, Operation and analysis of three phase half controlled converter, Effect of source Inductance on the performance of AC to DC converters, Power factor improvement, Harmonic reduction, filter.

Unit-III
DC to DC Converters: Types of basic DC-DC converters, Analysis of Buck converter (DC-DC) circuit, Commutation of thyristor based circuits, Introduction to switched mode power supply (SMPS) circuits, Fly-back type switched mode power supply, Forward type switched mode power supply, Design of transformer for switched mode power supply circuits.

Unit-IV
AC to AC Voltage converter: Three phase AC regulators, Phase angle control in Traic based single Phase AC regulators, Introduction to cyclo converters, three phases to single phase cyclo converters, three phase to three phase cyclo converters, Control circuit for three phase to three phase converter.

Unit-V

Introduction to voltage source Inverters, Analysis of 1-Phase square wave voltage source Inverter, 3-Phase voltage source with square wave output. 3-phase pulse width modulated inverter. Sine PWM and its realization, current source Inverter, Load commutated current source inverter.

Text Books:

1. M. D. Singh and K. B. Khanchandani," Power Electronics".
2. Ned Mohan, Tore M. Undeland, and William P. Robbins,"Power Electronics: Converters, Applications And Design, Media Enhanced (With CD)".
3. John G. Kassakian, Martin F. Schlecht, and George C. Verghese,"Principles Of Power Electronics".

Reference Books:

1. G. K. Mithal , Maneesha Gupta, "Industrial and Power Electronics", Khanna Publishers,1987.
2. George M. Chute, R. D. Chute, "Electronics in Industry", McGraw-Hill School Pub Co, 5th Edition

<table>
<tr><td>Course Title</td><td colspan="4">Data Structures
(Open Elective Course I)</td><td colspan="3">B.Tech V Sem (R20) CSE</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE501</td><td rowspan="2">OEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- To develop skills and analyze linear and nonlinear data structures.
- To understand basic concepts about linked lists, stacks, queues.
- To study algorithms as they apply to trees and graphs.
- To study in detail about sorting.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the variety of abstract data types and data structures.
CO 2	Analyze data structures such as linked list, Stacks and Queues.
CO 3	Apply and analyze tree traversal algorithms and graph traversal algorithms.
CO 4	Organize data in order using various sorting algorithms.

UNIT - I

Introduction: Data structures, Primitive & Non Primitive data structures, Linear & Non Linear data structures, **Linear Lists:** Definition, **Arrays:** Definition, **Linked Lists:** Single Linked List-Definition, Insertion and Deletion operations**,** Doubly Linked List- Definition, Insertion and Deletion operations. **Stacks:** Definition, Array & Linked representations, Operations, Applications.

UNIT – II

Queues: Definition, Array & Linked representations, Operations, Circular Queues & Dequeues.

Trees: Basic terminology, **Binary Trees -** Definition, Properties, Representation, Complete and Full Binary Tree, **Tree Traversal Algorithm:** Inorder, Preorder and Postorder.

UNIT – III

Binary Search Tree (BST): Definition, Operations & Implementations, Indexed BST.

Balanced Search Trees: AVL trees, Red-Black trees & Splay trees.

UNIT - IV

Graphs: Terminology, Representations, **Graph Traversal:** Depth First Search (DFS), Breadth First Search (BFS), Applications of graphs.

UNIT - V

Sorting: Selection, Insertion, Bubble, Heap, Quick Sort, Merge Sort.

Searching: Linear and Binary search.

Hashing: Introduction, Hash Table representation, Hash Functions.

Text Books:

1. An Introduction to Data Structures with applications, Jean Paul Trembley and Paul G.Sorenson, McGraw Hill.
2. Fundamentals of Data Structures in C, Horowitz, Sahni, Anderson Freed, Universities press.
3. Data Structures using C++, Varsha H.Patil, Oxford University Press.
4. Data Structures, Seymour Lipschutz, Schaum's Outlines, McGraw Hill.
5. Data Structures and Algorithms, G.A.V.Pai, Tata McGraw Hill.

Reference Books:

1. Data Structures, Algorithms and Applications in C++, AnandaRao Akepogu and Radhika Raju Palagiri, Pearson Education.
2. Data Structures and Algorithms in C++, S.Sahni, University Press (India) Private Limited, Second Edition.
3. Data Structures using C and C++, Langsam, Augenstein and Tanenbaum, PHI.

<table>
<tr><td>Course Title</td><td colspan="4">Database Management Systems
(Open Elective Course – I)</td><td colspan="3">B.Tech V Sem (R20) CSE</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE502</td><td rowspan="2">OEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
● To study the physical and logical database designs, database modeling, relational hierarchical, and network models.
● To understand and use data manipulation language to query, update, and managing the database.
● To develop an understanding of essential DBMS concepts such as: database secur integrity and concurrency.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">To understand the basic concepts and the application of Database systems.</td></tr>
<tr><td>CO 2</td><td colspan="8">To understand the basics of SQL and construct queries using SQL.</td></tr>
<tr><td>CO 3</td><td colspan="8">To understand the Relational Database design principles.</td></tr>
<tr><td>CO 4</td><td colspan="8">To apply various Normalization techniques for database design improvement.</td></tr>
<tr><td>CO 5</td><td colspan="8">To apply concurrency control and recovery techniques during transactionexecution.</td></tr>
</table>

UNIT-I

Introduction - Database-System Applications, View of Data, Database languages, Database architecture, Database Users and Administrators.

E-R Model - The Entity Relationship Model, Constraints, Entity Relationship Diagrams, and Extended E-R features.

UNIT-II

Relational Model - Structure of Relational Databases, Database Schema, Keys, Query Languages, Fundamental Relational Algebra Operations, Additional Relational Algebra Operations, Extended Relational Algebra Operations, Modification of Database.

UNIT-III

Introduction to SQL - Data Definition, Basic Structure of SQL Queries, Set Operations, Null Values, Aggregate Functions, Nested Sub queries, Complex queries, views, Modification of the Database.

Advanced SQL -Integrity Constraints, Dynamic SQL, Functions and Procedures.

Other Relational Query Languages - Tuple Relational Calculus, Domain Relational calculus.

UNIT-IV

Normal Forms – Atomic domain and First Normal Form, Keys and Functional Dependencies, Second Normal Form, BCNF, BCNF and Dependency Preservation, Third Normal Form, Lossless Decomposition, Dependency- preserving, Multi valued Dependencies, Fourth Normal Form, Join Dependencies, Fifth Normal Form, and Inclusion dependencies.

UNIT-V

Transactions -Transaction Concept, Transaction State, Implementation of Transaction Atomicity and Durability, Concurrent Executions, Serializability.

Concurrency Control -Lock-Based Protocols, Timestamp-Based Protocols. **Recovery System -** Failure Classification, Storage, Recovery and Atomicity, Log based recovery.

Text Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database system Concepts", 5thEdition, McGrawhill.
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamental Database Systems", Pearson Education, 3rd Edition, 2003
3. C.J.Date, "Introduction to Database", 8 Th Edition, 2003, Addison-Wesley publication.
4. Hector Garcia Molina, Jeffrey D. Ullman, Jennifer Widom, "Database System Implementation", Pearson Education, United States 1st Edition, 2000

Reference Books:

1. Raghurama Krishnan, Johannes Gehrke, Data base Management Systems.3rd Edition, Tata McGrawHill.
2. Peter Rob, Ananda Rao and Carlos Corone, Database Management Systems, Cengage Learning, 1st Edition, 2011
3. Thomas Connolly, Carolyn Begg, Database Systems: A Practical Approach to Design, Implementation and Management,6th Edition,2012.
4. S.K.Singh, "Database Systems Concepts, Design and Applications", First Edition, Pearson Education, 2006.

Reference Links:

1. https://nptel.ac.in/courses/106/105/106105175/ (IIT KHARAGPUR)
2. https://nptel.ac.in/courses/106/106/106106095/ (IIT MADRAS)

<table>
<tr><td>Course Title</td><td colspan="4">Employability Skills</td><td colspan="3">B.Tech.
Open Elective-I</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE601</td><td rowspan="2">OEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 90 Min</td><td colspan="3">External Exam Duration: 3 Hrs</td></tr>
</table>

Introduction: Employability skills play an important role in one's career. Professional skills are a person's skill set and ability to perform a certain type of activity or task. Employability skills are a person's ability to interact effectively with co-workers and customers. Hard skills are mainly applicable at the work place. Employability skills are applicable both at workplace and outside the work place. Employability skills complement the hard skills which are occupational requirement of a job. It also complements many other activities even outside the work place. Presently employability skills are increasingly sought out by employers in addition to standard qualification. There are instances of professions where employability skills proved to be more important, on a long term basis than occupational skills. Employability skills refer to behavior, communication, IT Skill, work ethics etc. which makes a person suitable to effectively work in a team. Studies suggest that employability skills are equally important indication of job performance as hard skills. The competency level of the worker increases with the Employability skills and takes him to the next level.

Course Objectives: The main objective of this course is to make the the students

i. Demonstrate effective presentations

ii. Develop and practice self-management skills

iii Assess and improve personal grooming

iv. Create safety awareness including rules and procedures on the work site.

v. Survey the required skills for discussing and resolving problems in the work arena.

Course Outcomes: On success Completion This course ,the students will be able to

CO1	Demonstrate presentations
CO2	Develop and practice self-management skills
CO3	Assess and improve personal grooming
CO4	Create safety awareness including rules and procedures on the work site.
CO5	Survey the required skills for discussing and resolving problems in the work arena.

UNIT–1 Communication and Teamwork – Communicating effectively, Interpersonal and Intrapersonal skills, A good leader, Leadership behavior, Assertiveness skills.

UNIT -2 Etiquette and Manners – Social and Business. Time Management – Concept, Essentials

Tips – prioritization, Kinesics, Adaptability Skills.

UNIT –3 Decision-Making and Problem-Solving Skills: Meaning, Types and Models, Ethical Decision-Making, Problems and Dilemmas in application of these skills. Conflict - Definition, Nature, Types and Causes; Methods of Conflict Resolution, Conflict Management.

UNIT -4 Stress Management: Stress - Definition, Nature, Types, Symptoms and Causes; Stress Analysis Models and Impact of Stress; Measurement and Management of Stress.

UNIT –5 Interview and Presentation Skills: Definition, in-depth perspectives of interviewer and interviewee, preparation – before, during, after, overcoming nervousness, tips for success, Interviewer and Interviewee – Presentation Skills: Types, Content, Audience Analysis, Essential Tips

References:

1. Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press, 2011.

2. S.P. Dhanavel, English and Soft Skills, Orient Blackswan, 2010.

3. R.S.Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S.Chand& Company Ltd., 2018.

4. Raman, Meenakshi& Sharma, Sangeeta, Technical Communication Principles and Practice, Oxford University Press, 2011.

5. Managing Soft Skills for Personality Development – edited by B.N.Ghosh, McGraw Hill India, 2012. 6. English and Soft Skills – S.P.Dhanavel, Orient Blackswan India, 2010.

<table>
<tr><td>Course Title</td><td colspan="4">ADVANCED NUMERICAL METHODS (R20)</td><td colspan="3">OPEN ELECTIVE - I</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE602</td><td rowspan="2">OEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>--</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hours</td></tr>
</table>

Course Objectives:

1. To solve algebraic, transcendental equations and system of linear equation by various methods.
2. To interpolate and approximate equal and unequal intervals by various formulae.
3. To discuss approximation of numerical differentiation and integration.
4. To solve Ordinary Differential Equations (ODEs) in initial value problems (IVPs) by various methods.
5. To solving ODEs & partial Differential Equations (PDEs) in boundary value problems (BVPs) by various methods.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the basic knowledge on solution of system of equations.
CO 2	Use interpolation and approximation to solve engineering problems.
CO 3	Estimate the numerical differentiation and integration.
CO 4	Apply initial value problems for solving first order differential equation.
CO 5	Discuss the boundary value problems in ordinary and partial differential equations.

UNIT I:

Solution of Equations: Solution of algebraic and transcendental equations- Fixed point iteration method, Horner’s Method.

Solution of linear system of equations: Gauss Crout’s Method, Relaxation method.

UNIT II: Interpolation and Approximation

Finite Differences-Other Difference Operators- To find one or more missing terms. Divide Difference - Newton’s divided difference interpolation, Inverse interpolation formula.

UNIT III: Numerical Differentiation and Integration

Numerical differentiation: Finding first and second order derivatives using Newton’s formulae. Numerical integration: Newton - Cote’s quadrature formulae, Trapezoidal rule, Simpson’s 1/3 rule, Simpson’s 3/8 rule.

UNIT IV:Initial Value Problems for Ordinary Differential Equations

Single Step methods: Taylor’s series method, Euler’s method, Fourth order Runge - Kutta method for solving first order equations.

Multi step method: Milne’s predictor - corrector method.

UNIT V: Boundary Value Problems in Ordinary and Partial Differential Equations

Finite difference methods for solving two-point linear boundary value problems - Finite difference techniques for the solution of two dimensional Laplace's equation.

Text books:

1. Grewal.B.S., and Grewal.J.S., "Numerical methods in Engineering and Science", Khanna Publishers, 9th Edition, New Delhi, 2007.
2. Kandasmay,P; Thilagavathy, K; Gunavathi, K, Numerical Methods, S.Chand And Company Ltd, 2007.
3. Applied Numerical Analysis, Pearson Publishers, 7th Edition, Curtis F. Gerald, Patrick O. Wheatley.
4. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Publications, 10th edition Reprint 2021.

Reference Books:

1. Chapra.S.C., and Canale.R.P., "Numerical Methods for Engineers, Tata McGraw Hill, 5th Edition, New Delhi, 2007.
2. Sankara Rao. K., "Numerical methods for Scientists and Engineers", Prentice Hall of India Private, 3rd Edition, New Delhi. 2007.
3. Applied Numerical Methods with MATLAB for Engineers and Scientists, Special Indian Edition, Steven C Chapra.
4. Advanced Engineering Mathematics, Neil Opeter V.

<table>
<tr><td>Course Title</td><td colspan="5">ENGINEERING MATERIALS</td><td colspan="3">OPEN ELECTIVE- 1</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE607</td><td rowspan="2">BSC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End lab Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5"></td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

COURSE OBJECTIVES:

1.This introductory course is aimed to obtain basic exposure to the concepts of crystalline solids, its imperfections and basics of various advance engineering materials finding wide spread application in several industries.
2.Describe the process that is used to produce glass-ceramics.
3.To enlighten the periodic arrangement of atoms in crystals to provide fundamentals related to structural analysis through powder diffraction method.
4.Understanding these material systems are vital for investigating the defects and their nature on these classes of materials.

Course Outcomes: Upon completion of the course, the student will be able to:	
CO1	**Classify** various crystal systems.
CO2	**Explain** the applications of magnetic materials.
CO3	**Analyze** the various metallurgical factors influencing the performance of materials for different Structural engineering applications.
CO4	**Interpret** Lorentz field and Claussius-Mosotti relation in dielectrics.
CO5	**Identify** applications of semiconductors in electronic devices .

Unit –I: Structure of Metals

Introduction-Different types of bonding in solids – Space lattice, Basis, unit cell and lattice parameters – Bravais Lattice – Crystal systems – Packing fraction – Coordination number – Packing fraction of SC, BCC .

Unit– II: Magnetic Materials

Introduction to magnetic materials - Classification of magnetic materials: Dia, Para & Ferro – Domain concept of Ferromagnetism (Qualitative) – Hysteresis loop– Soft and Hard magnetic materials.

Unit– III: Ceramics

Introduction-Types and applications of ceramics- Glasses - Glass-Ceramics - Clay Products - Refractories - Abrasives Cements - Advanced Ceramics - Materials of Importance—Piezoelectric Ceramics

Unit –IV: Dielectric Materials

Introduction to Dielectrics-Electric polarization- Dielectric polarizability, Susceptibility and Dielectric constant-Types of polarizations(Qualitative)–Frequency dependence of polarization-Lorentz(internal) field-Classius-Mosotti equation- Applications of Dielectrics

Unit –V: Electrical Properties of materials

Electrical conduction: - Ohm’s Law - Electrical Conductivity- Electronic and Ionic Conduction - Energy Band Structures in Solids.

Semiconductivity:- Intrinsic Semiconductor - Extrinsic Semiconductor - The Temperature Dependence of Carrier Concentration - Hall Effect - Applications

Text Books:

1. Callister’s Materials Science and Engineering: Wiley, Second Edition, (2018)
2. V. Raghavan, Materials Science and Engineering, Prentice Hall of India, 5th edition (2013).
3. G.E. Dieter, Mechanical Metallurgy, Mc-Graw Hill, 3rd edition (2013).

Reference Books:

1. L. H. Van Vlack, Elements of Materials Science and Engineering, Addison Wesley, 6th edition (1989).
2. I. J. Polmear, Light Alloys: Metallurgy of the Light Metals, Wiley, 3rd edition (1995).
3. V. Raghavan, Physical Metallurgy: Principles and Practice, PHI Learning Private Limited, 2nd edition (2006).

<table>
<tr><td>Course Title</td><td colspan="5">Basics of Nanotechnology</td><td colspan="3">B. Tech.
(Open elective-I)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE604</td><td rowspan="2">Open Elective</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Min</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
• To make the students acquire an understanding the Nanoscience and Applications
• Student will be able to understand and control matter at the nanoscale leads to a revolution i technology and industry that benefits society.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Acquire knowledge about structure and properties of nano materials</td></tr>
<tr><td>CO 2</td><td colspan="8">Synthesis of nanomaterials by various methods & their applications</td></tr>
<tr><td>CO 3</td><td colspan="8">Identify and understand various top-down and bottom-up approaches for nanomaterial synthesis</td></tr>
<tr><td>CO 4</td><td colspan="8">Correlate properties of nanostructures with their size, shape</td></tr>
<tr><td>CO 5</td><td colspan="8">Appreciate enhanced sensitivity of nanomaterial-based sensors and their novel applications in industry</td></tr>
</table>

Unit-I: Introduction

History and Scope, Introduction to nanomaterials, Classification of nanomaterials with suitable examples, Structure of different nanomaterials- Graphenes, CNT's, Fullerene, Properties of nanomaterials-Chemical, Optical, Thermal , Electrical Mechanical.

Learning Outcomes:

At the end of the unit, The students will be able to

- Classification of nanomaterials.
- Identify different structures of nanomaterials.

Unit-2: Synthesis of Nanomaterials

Chemical precipitation and Co-precipitation, Sol-gel synthesis, Electrochemical synthesis, Photochemical synthesis, Evaporation method-Principal & its uses

Learning Outcomes:

At the end of the unit, The students will be able to

- Explain Sol-gel method.
- Discuss electrochemical and chemical methods of synthesis.

Unit-3: Fabrication of Nanomaterials

Top-Down method (Ball milling), Bottom-up method (chemical vapour deposition method, Sol gel method), Self-assembly method, Electric arc method. Nanocomposite fabrication.

Learning Outcomes:

At the end of the unit, The students will be able to

- Explain methods used in fabrication of different nanomaterials

Unit-4: Properties of Nanomaterials
Importance of nano particle, effect of Size on optical, electronic, photonic, mechanical, magnetic and catalytic properties.

Learning Outcomes:
At the end of the unit, The students will be able to

- Explain the importance of nano particles.
- Discuss the effect of size on different properties.

Unit-5: Applications of Nanomaterials

Applications of Nano electronics, Nanooptics, Nano scale chemical & biosensing, biological/ Biomedical applications, Photo voltaic fuel cells-Related applications

Learning Outcomes:
At the end of the unit, The students will be able to

- Know the applications of nanomaterials in different fields.

Textbooks:
1. Text Book of Engineering Chemistry, Shashi Chawla, Dhanapath Rai Publications, New Delhi, 4th Edition, 2011.
2. Textbook of Nanoscience and Nanotechnology in Engineering, Marcel Van de Voorde (Ed.), De Gruyter publications
3. Nanoparticles-Biological activities and nanotechnology, Mindy Adams, NY Research Press
4. Theory and applications of Nano particals, Andrew Green, NY Research Press

Reference Books:
1. Textbook of Nanoscience & Nanotechnology, B.S. Murthy p. Shankar Baldev, University Press-IIM
2. Nanotechnology- A future technology with Visions-BPB Publications
3. Nanotribology, edited by Stephen M. Nsu, Z. Charles Ying, Springer International Edition
4. Introduction to Nanotechnology, Charles P. Poole Jr. Frank J. Owens, Willey Students Editions.

<table>
<tr><td>Course Title</td><td colspan="4">WRITE IT RIGHT</td><td colspan="3">OPEN ELECTIVE - I</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE605</td><td rowspan="2">HUM</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>--</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Min</td><td colspan="4">End Exam Duration: 3Hours</td></tr>
<tr><td colspan="9">Course Objectives:
1.To help students get the basics right.
2.To grasp the nature of the writing exercise one has embarked upon
3. To promote effective writing across a whole range of tasks that all of us face on a daily basis</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Utilize effective techniques for writing job applications /course application.</td></tr>
<tr><td>CO 2</td><td colspan="8">Recall the contents to make use of good paragraph writing.</td></tr>
<tr><td>CO 3</td><td colspan="8">Identifying grammatical errors and can make necessary corrections.</td></tr>
<tr><td>CO 4</td><td colspan="8">Demonstrate effective grammatical skills in English.</td></tr>
<tr><td>CO 5</td><td colspan="8">Paraphrase a piece of writing and summarize it easily.</td></tr>
</table>

Syllabus:

Unit 1.

1. The logic of Effective Writing
2. Applying for a course: Applying for a job
3. Writing Correct and Convincing sentences

Unit 2:

1. Generating Ideas through Prewriting
2. Using the Patterns of Paragraph Development:
    a. Narration
    b. Description
    c. Argument
    d. Exposition

Unit 3:

1. Punctuation – list of punctuation marks- their usage for effective written communication
2. Misplaced modifiers
3. Confused words

4. Common mistakes in English

5. The Right Use of the definite article

Unit4:

1. Report writing – types – sample reports

2. e-mail writing

3. Elements of good essay

Unit 5:

1. Precise Writing

2. Developing of an idea/ Expansion

3. Note-making

Text books:

1. Write it Right: A Handbook for Students authored by John Peck and Martin Coyle published by Palgrave Macmillan in New York and Hampshire in 2005.

2. Odyssey- A Guide to Better Writing by William. J. Deborah Lawton Published by Allyn and Bacon.

Reference books

1. Heffron, Jack (ed). The Best Writing on Writing. Story Press, Cincinnati, Ohio, 1994.

2. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.

3. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012.Oxford Learners Dictionary, 12 th Edition, 2011

<table>
<tr><td>Course Title</td><td colspan="4">Human Capital Management</td><td colspan="3">B.Tech. Open Elective-1</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE606</td><td rowspan="2">Open Elective (OEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 90 Min</td><td colspan="3">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives: The objective of the course is

- ToenablethestudentstounderstandtheHRManagementandsystematvariouslevelsingeneralandincertainspecificindustriesororganizations.
- To help the students focus on and analyze the issues and strategies required to select and develop man power resources.
- To develop relevant skills necessary for application in HR related issues.
- ToEnablethestudentstointegratetheunderstandingofvariousHRconceptsalongwiththedomainconceptinordertotakecorrectbusinessdecisions.

Course Outcomes: On successful completion of this course, the students will be able to

CO1	UnderstandingofrolesandresponsibilitiesofHRdepartmentinindustries.
CO2	Have knowledge to understand job analysis and design jobs.
CO3	Understand job evaluation and estimate HR requirements.
CO4	Able to conduct recruitment & selection process.
CO5	Abletounderstandtrainingmethods.Haveclarityofemployeecompensation

Unit-I

Introduction of HRM: Nature, scope, objectives, Importance and functions, Evolution of the concept of HRM, Human resource management in India; Roles of HR manager, Practice in Industry

Unit-II

Job Analysis &Design: Job Analysis-Meaning, Uses, Process and methods of collecting data for job analysis, Job Description, Job Specifications, Factors affecting Job Design, Techniques of Job Design.

Unit-III

Job Evaluation and Human Resources Planning: Objectives of Job Evaluation; Advantages and

Limitations of Job Evaluation, Human Resources Planning (HRP), Need and Benefits of HRP, Process of HRP ,Factors Affecting HRP, Responsibility for HRP.

Unit-IV

Recruitment & Selection: Factors Affecting Recruitment; Sources of Recruitment; Selection Process, Methods of selection-Interviews, Tests, Need for Training and Methods of Training.

Unit-V

Human Resource Development: Meaning, Definition of HRD, objectives, Significance, functions and HRD process.

Text Books:

1. HumanResourceandPersonnelManagement-TextandCases:K.Ashwathappa,TataMcGrawHillEducationPvt.Ltd.
2. PersonnelandHumanResourceManagement-P.SubbaRao,HimalayaPublishing.
3. Human Resource Management – John M Lvancevich (1988) Publish – Irwin Mcgraw Hill.
4. Human Resource Management – Greg L. Stweart John wiley & sons, Inc Publications.
5. Human Resource Development_ Mohammad mohsim (2010) Publisher Vdm Verldg Dr. Muller.

Reference Books:

1. Human Resource Management: P.Jyothi, Publication,OxfordUniversityPress

<table>
<tr><td>Course Title</td><td colspan="5">Data Mining Lab</td><td colspan="3">B.Tech. V Sem (R20UG) AI&ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039508</td><td rowspan="2">PCC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5"></td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- The different data mining models and techniques will be discussed in this course.
- Data mining and data warehousing applications in bioinformatics will also be explored.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the data mining process and important issues around data cleaning, pre - processing and integration.
CO 2	Understand the principle algorithms and techniques used in data mining, such as clustering, association mining, classification and prediction.

Credit Risk Assessment

Description: The business of banks is making loans. Assessing the credit worthiness of an applicant is of crucial importance. You have to develop a system to help a loan officer decide whether the credit of a customer is good, or bad. A bank's business rules regarding loans must consider two opposing factors. On the one hand, a bank wants to make as many loans as possible. Interest onthese loans is the banks profit source. On the other hand, a bank cannot afford to make too many badloans. Too many bad loans could lead to the collapse of the bank. The bank's loan policy must involve a compromise: not too strict, and not too lenient.

To do the assignment, you first and foremost need some knowledge about the world ofcredit. You can acquire such knowledge in a number of ways.

1. Knowledge Engineering. Find a loan officer who is willing to talk. Interview her and try to represent her knowledge in the form of production rules.
2. Books. Find some training manuals for loan officers or perhaps a suitable text book onfinance. Translate this knowledge from text form to production rule form.
3. Common sense. Imagine yourself as a loan officer and make up reasonable rules whichcan be used to judge the credit worthiness of a loan applicant.
4. Case histories. Find records of actual cases where competent loan officerscorrectly judged when, and when not to, approve a loan application.

The German Credit Data:

Actual historical credit data is not always easy to come by because of confidentiality rules. Here is one such dataset, consisting of 1000 actual cases collected in Germany. credit dataset (original) Excel spreadsheet version of the German credit data (Down load from web).

In spite of the fact that the data is German, you should probably make use of it for thisassignment. (Unless you really can consult a real loan officer!)

A few notes on the German dataset

- DM stands for Deutsche Mark, the cents Canadian (but looks and acts like a quarter).
- Owns telephone. German phone rat so fewer people own telephones.
- Foreign here are worker millions of these. Tin Germany (many from Turrkey). It is very hard toget German citizenship if you were not born of German parents.
- There are 20 attributes used in the classify the applicant into one of two categories, good orbad.

Subtasks: (Turn in your answers to the following tasks)

1. List all the categorical (or nominal) attributes and the real-valued attributes separately.
2. What attributes do you think might be crucial in making the credit assessment? Come up with some simple rules in plain English using your selected attributes.
3. One type of model that you can create is a Decision Tree - train a Decision Tree using the complete dataset as the training data. Report the model obtained after training.
4. Suppose you use your above model trained on the complete dataset, and classify credit good/bad for each of the examples in the dataset. What % of examples can you classify correctly? (This is also called testing on the training set) Why do you think you cannot get 100 % training accuracy?
5. Is testing on the training set as you did above a good idea? Why or why not?
6. One approach for solving the problem encountered in the previous question is using cross validation? Describe what is cross-validation briefly. Train a Decision Tree again using cross-validation and report your results. Does your accuracy increase/decrease? Why? (10 marks)

Text Books:

1. Data Mining: Concepts and Techniques, Jiawei Han, MichelineKamberand Jian Pei,Morgan Kaufmann Publishers, Elsevier, Third Edition,2012.
2. Data Warehousing in the Real world, Sam Aanhory& Dennis Murray, PearsonEducation, Asia.
3. Intelligent Data Mining, Da Raun.Guoquing Chen, Etienne E. Kerre. Geert Wets,Springer.
4. Data Mining & Data Warehousing: Principles and Practical Techniques, Parteek Bhatia, Cambridge.

Reference Books:

1. Data Mining Techniques, Arun K Pujari, Second Edition, Universities Press.
2. Insight into Data Mining, K.P.Soman, S.Diwakar , V.Ajay, PHI2008.
3. Data Mining: Introductory and Advanced Topics, Margaret H. Dunhan, Pearson.
4. Data Mining, Vikram Pudi, P. Radha Krishna, Oxford Higher Eduction.

<table>
<tr><td>Course Title</td><td colspan="4">Mobile App Development
(Skill Course – III)</td><td colspan="4">B.Tech. V Sem (R20UG) AI&ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039509</td><td rowspan="2">SC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>1</td><td>0</td><td>2</td><td>2</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5"></td><td colspan="4">End Exam Duration: 3 Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
• To understand fundamentals of android operating systems.
• Illustrate the various components, layouts and views in creating android applications.
• To understand fundamentals of android programming.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Develop applications using services and publishing android applications.</td></tr>
<tr><td>CO 2</td><td colspan="8">To demonstrate their skills of using Android software development tools.</td></tr>
</table>

LIST OF EXPERIMENTS

1. Setting up the Development Environment
   a. Installation of JDK and Setting path
   b. Downloading and Installing Android Studio
2. Creating "Hello World" Application and viewing the output through emulator.
3. Creating the Application by using Activity class
   i) On Create () ii) on Start () iii) on Resume () iv) on Pause ()
   v) On Stop () vi) on Destroy () vii) on Restart ()
4. Create the Application using the Edit Text control.
5. Create the Application Choosing options.
   i) Check Box ii) Radio Button iii) Spinner
6. Create the applications using different layouts.
   i) Linear Layout ii) Relative Layout iii) Absolute Layout iv) TableLayout
7. Create the application for doing arithmetic operations. (Calculator)
8. Create the application to play the audio and video clips.
9. Create the application by using menus and action bar.

Text Books:

1. Android Programming by B.M Harwani, Pearson Education, 2013.
2. T1. Lauren Darcey and Shane Conder, “Android Wireless ApplicationDevelopment”, Pearson Education, 2nd ed. (2011)
3. Android application Development for Java Programmers, James C Sheusi, CengageLearning
4. Android In Action by W.Frank Ableson, Robi Sen, Chris King, C. EnriqueOrtiz.,Dreamtech.

Reference Books:

1. Beginning Android 4 Application Development, by Wei-Meng Lee , Wiley India.
2. Android Programming for Beginners, John Horton, 2nd Edition, Packt.

3. Android App Development for Dummies, Michael Burton, 3rd Edition, Wiley.

Course Title	Environmental Science (Mandatory Course)					B.Tech. V Sem (R20UG) AI&ML		
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
20MC510	**MC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	**--**	**--**	**0**	**40**	**--**	**--**
Mid Exam Duration: 2Hrs								

Course Objectives:

- To make the students to get awareness on environment.
- To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life.
- To save earth from the inventions by the engineers.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	**Explain** multidisciplinary nature of environmental studies and various Renewable and Nonrenewable resources.
CO 2	**Understand** the Energy flow, bio-geo chemical cycles and ecological pyramids
CO 3	**Illustrate** various causes of pollution and related preventive measures.
CO 4	**Summarize** Solid waste management, Social issues related to environment and their protection acts.
CO 5	**Evaluate** Causes of population explosion, value education and welfare programmes.

UNIT – I

Multidisciplinary Nature of Environmental Studies: –Scope and Importance – Need for Public Awareness.

Natural Resources: Renewable and non-renewable resources – Natural resources and associated problems

Forest resources: deforestation, case studies – Mining, dams and other effects on forest and tribal people

Water resources: Use and over utilization of surface and ground water conflicts over water.

Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

Energy resources: Renewable &Non-Renewable.

Learning Outcomes

- **Explain** the importance of public awareness
- **List** the various natural resources.

UNIT – II

Ecosystems: Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Food chains, food web- Ecological succession and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:

- **a.** Forest ecosystem.
- **b.** Desert ecosystem
- **c.** Aquatic ecosystems (lakes, rivers and oceans)

Biodiversity And Its Conservation : Introduction, Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Learning Outcomes:

- **Understand** different types of eco systems and their characteristics.
- **Classify** types of biodiversity and its conservation methods.

UNIT – III

Environmental Pollution: Definition, Cause, effects and control measures of:

- **a.** Air Pollution.
- **b.** Water pollution
- **c.** Soil pollution
- **d.** Marine pollution
- **e.** Noise pollution
- **f.** Thermal pollution
- **g.** Nuclear hazards

Solid Waste Management: Causes**,** effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

Learning Outcomes:

- **Identify** various sources of pollution and solid waste along with preventive measures
- **Explain** the different types of disasters and their managerial measures.

UNIT – IV

Social Issues and The Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents. Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act.

Learning Outcomes:

- **Outline** the social issues related to environment and their protection acts.(L2)
- **To know** about wild life protection , forest conservation act and conservation of natural resources (L2)

UNIT – V

Human Population And The Environment: Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health.

Field Work: Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes, etc.

Learning Outcomes:

- **Illustrate** about the population explosion and family welfare programmes.(L2)
- **To identify** the natural assets and related case studies.(L3)

Text Books:

1. Text book of Environmental Studies for Undergraduate Courses, Erach Bharucha for University Grants Commission, Universities Press.
2. Fundamental Concepts of Environmental Chemistry- Sodhi G S – Oxford University
3. Environmental Chemistry- Anil Kumar De-Willey Publications
4. Environment Impact Assessment- Larry W. Canter- Mc Graw Hill publications.

Reference Books:

1. G.R.Chatwal, “A Text Book of Environmental Studies” Himalaya Publishing House
2. Gilbert M. Masters and Wendell P. Ela, “Introduction to Environmental Engineering and Science, Prentice hall of India Private limited.
3. Environmental Science, A Global Concerns, William P. Cunningham, Mary Ann Cunningham, Mc Graw Hill publications.
4. Environmental Science & Engineering, Glynn Henry J ,Heinke Gary w, Pearson publications.

<table>
<tr><td>Course Title</td><td colspan="4">Community Service Project</td><td colspan="3">B.Tech. V Sem (R20UG) AI&ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039510</td><td rowspan="2">PROJ</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>-</td><td>-</td><td>3</td><td>1.5</td><td>100</td><td>-</td><td>100</td></tr>
<tr><td colspan="5">Internal Evaluation</td><td colspan="4"></td></tr>
<tr><td colspan="9">Course Objectives:
• The objective of the project is to enable the student to take up investigative study in rural areas / Community in the field of Computer Science and Engineering.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand core concepts and research findings relative to human development, socialization, group dynamics and life course processes.</td></tr>
<tr><td>CO 2</td><td colspan="8">Identify and transfer existing ideas into new contexts and applications.</td></tr>
<tr><td>CO 3</td><td colspan="8">Apply and transfer academic knowledge into the real-world.</td></tr>
<tr><td>CO 4</td><td colspan="8">Design a component or a product applying all the relevant standards and with realistic constraints.</td></tr>
</table>

The following are the rules and regulation for **Community Service Project Projects:**

1. The student has to spend 50 to 60 Hrs in the semester on any Community Service Project andsubmit a report for evaluation.
2. The project is evaluated for 100 marks in the semester by a committee consisting of head of the department, project mentor and one senior faculty member of the department.
3. A student shall acquire 2 credits assigned, when he/she secures 50% or more marks from the totalof 100 marks.
4. In case, if a student fails, he/she shall resubmit the report.
5. There is no external evaluation for the Community Service Project.

B.Tech VI SEM AI&ML (R20)

<table>
<tr><th>Course Title</th><th colspan="5">Deep Learning</th><th colspan="3">B.Tech. VI Sem (R20UG) AI&ML</th></tr>
<tr><th>Course Code</th><th>Category</th><th colspan="3">Hours / Week</th><th>Credits</th><th colspan="3">Maximum Marks</th></tr>
<tr><td rowspan="2">2039601</td><td rowspan="2">PCC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 90 Minutes</td><td colspan="3">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- To introduce the fundamentals of deep learning and the main research activities in this field.
- To learn architectures and optimization methods for deep neural network training.
- Study the neural networks and convolutions networks and their architecture.
- Gain knowledge about recurrent neural networks and deep supervised learning methods.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the fundamentals of deep learning.
CO 2	Compare various deep neural network architectures.
CO 3	Apply various deep learning algorithms based on real-world applications.
CO 4	Understand the convents.
CO 5	Understand the recurrent neural networks.

UNIT – 1

Linear Algebra Review and Optimization: Brief review of concepts from Linear Algebra, Types of errors, bias-variance trade-off, overfitting-under fitting, brief review of concepts from Vector Calculus and optimization, variants of gradient descent, momentum.

UNIT – II

Logistic Regression: Basic concepts of regression and classification problems, linear models addressing regression and classification, maximum likelihood, logistic regression classifiers.

UNIT – III

Neural Networks: Basic concepts of artificial neurons, single and multi-layer perceptron, perceptron learning algorithm, its convergence proof, different activation functions, SoftMax cross entropy loss function.

UNIT – IV

Convnets: Basic concepts of Convolutional Neural Networks starting from filtering. Convolution and pooling operation and arithmetic of these, Discussions on famous convent architectures - AlexNet, ZFNet, VGG, Google Net, Res Net, MobileNet-v1

Regularization, Batchnorm: Discussion on regularization, Dropout, Batchnorm, Discussion on detection as classification, region proposals, RCNN architectures.

UNIT – V

Recurrent Neural Networks: Basic concepts of Recurrent Neural Networks (RNNs), backpropagation through time, Long-Short Term Memory (LSTM) architectures, the problem of exploding and vanishing gradients, and basics of word embedding.

Auto Encoders: Autoencoders, Denoising autoencoders, sparse autoencoders, contractive Autoencoders.

Text Books:

1. Ian Goodfellow, YoshuaBengio, Aaron Courville. Deep Learning, the MIT press, 2016
2. Bengio, Yoshua. " Learning deep architectures for AI." Foundations and trends in Machine Learning 2.1, Now Publishers, 2009.

Reference Books:

1. B. Vegnanarayana, Artificial Neural Networks, Prentice Hall of India, 2005.
2. Simon Haykin, Neural Networks a Comprehensive Foundations, PHI Edition, 2005.
3. Chao Pan, Deep Learning Fundamentals: An Introduction for Beginners, AI Sciences Publisher.

<table>
<tr><td>Course Title</td><td colspan="5">Software Engineering</td><td colspan="3">B.Tech. VI Sem (R20UG) AI&ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039602</td><td rowspan="2">PCC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3 Hrs</td></tr>
</table>

Course Objectives:

- Knowledge of basic Software engineering methods and practices, and their appropriate application also the software engineering layered technology and Process frame work.
- A general understanding of software process models such as the waterfall and evolutionary models.
- Understanding of the role of project management including planning, scheduling, risk management, etc.
- Understanding of data models, object models, context models and behavioral models also different software architectural styles.
- Understanding of software testing approaches such as unit testing and integration testing other testing strategies and Risk management.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Ability to apply software engineering principles and techniques.
CO 2	Ability to develop, maintain and evaluate large-scale software systems.
CO 3	To produce efficient, reliable, robust and cost-effective software solutions.
CO 4	To manage time, processes and resources effectively by prioritizing competing demands to achieve personal and team goals Identify and analyzes the common threats in each domain.

UNIT - I

Software and Software Engineering: The Nature of Software, Software Engineering, SoftwareProcess Software Myths. Process Models: A Generic Process Model, Prescriptive Process Models, Specialized Process Models, The Unified Process, Personal and Team Process Models.

UNIT - II

Understanding Requirements: Requirements Engineering, Establishing the Groundwork, Eliciting Requirements, Building the Requirements Model, Negotiating Requirements, Validating Requirements.

Requirements Modeling: Requirements Analysis, Scenario-Based Modeling, Data ModelingConcepts, Class-Based Modeling.

UNIT - III

Design Concepts: Design within the Context of Software Engineering, Design Process, DesignConcepts, The Design Model.

Architectural Design: Software Architecture, Architectural Genres, Architectural Styles, Architectural Design.

UNIT - IV

User Interface Design: The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation.

Coding and Testing: Testing, Testing in the Large versus Testing in the Small, Unit Testing,Integration Testing, Black-Box Testing, White-Box Testing, Debugging, System Testing.

UNIT - V

Software Project Management: Project Planning, Metrics for Project Size Estimation, Project Estimation Techniques, Empirical Estimation Techniques, COCOMO-A Heuristic Estimation Technique, Halstead‘s Software Science-An Analytical Technique, Risk Management.

Text Books:

1. Software Engineering: A practitioner’s Approach, Roger S. Pressman, Seventh Edition, 2010, McGraw Hill International Edition.
2. Fundamentals of Software Engineering, Rajib Mall, 4th Edition, 2014, PHI.
3. Software Engineering, Ian Sommerville, Ninth edition, Pearson education.
4. Software Engineering: A Primer, Waman S Jawadekar, Tata McGraw-Hill, 2008

Reference Books:

1. Software Engineering, A Precise Approach, Pankaj Jalote, Wiley India,2010.
2. Software Engineering, Principles and Practices, Deepak Jain, Oxford University Press.
3. Software Engineering1: Abstraction and modeling, Diner Bjorner, Springer International edition, 2006.
4. Software Engineering2: Specification of systems and languages, Diner Bjorner, Springer International edition, 2006.
5. Software Engineering Foundations, Yingxu Wang, Auerbach Publications,2008.

Course Title	Predictive Analytics Modeler					B.Tech. VI Sem (R20UG) AI&ML		
Course Code	Category	Hours / Week			Credits	Maximum Marks		
2039603	PCC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 90 Minutes					End Exam Duration: 3Hrs			

Course Objectives:

- The Predictive Analytics Modeler career path prepares students to learn the essential analytics models to collect and analyze data efficiently.
- This will require skills in predictive analytics models, such as data mining, data collection and integration, nodes, and statistical analysis.
- The Predictive Analytics Modeler will use tools for market research and data mining in order to predict problems andimprove outcomes.

Course Outcomes: On successful completion of this course, the students will be able to

CO1	The importance of analytics and how its transforming the world today
CO2	Understand how analytics provided a solution to industries using real case studies
CO3	Explain what is analytics, the various types of analytics, and how to apply it
CO4	Improve efficiency, sample records, and work with sequence data
CO5	Explain data transformations, and functions

Hardware Requirements	
Classroom (ILT) Setup Requirements	
Processor	Intel Core i7 CPU @ 2.7 GHz
GB RAM	8 GB
GB free disk space	60 GB
Network requirements	No
Other requirements	IBM ID

Notes: The following unit and exercise durations are estimates, and might not reflect every class experience. If the course iscustomized or abbreviated, the duration of unchanged units will probably increase.

Course Agenda:

MODULE I – Analytics Overview	
Course I – Business Analytics Overview (Duration: 01 Hour)	
Course Introduction: (Duration: 05 Minutes)	
Unit – I: Analytics overview (Duration: 10 Minutes)	
Overview	This unit provides an understanding of the importance of business analytics in our world,society, and life
Learning objectives	After completing this unit, you should be able to: • Understand how analytics is transforming the world • Understand the profound impact of analytics in business decisions • Understand what is analytics and how it works • Understand why business analytics has become important in various industries
Unit – 2: Analytics trends: Past, present & future (Duration: 15 Minutes)	

		Overview	This unit explains how analytics has evolved over time
		Learning objectives	After completing this unit, you should be able to: • Understand the history of analytics and how it has changed today • Understand how to analyze unstructured data • Understand how analytics is making the world smarter • Understand where the future of analytics lies
		Unit – 3: Towards a predictive enterprise (Duration: 05 Minutes)	
		Overview	This unit explains the effects of business analytics in the corporate world that has led to itsglobal adoption across geographies and industries
		Learning objectives	After completing this unit, you should be able to: • Explain why successful enterprises need business analytics • Understand how business analytics can help turn data into insight
		Unit – 4: Analytics: Industry domains (Duration: 05 Minutes)	
		Overview	This unit highlights the application of analytics across major industries.
		Learning objectives	After completing this unit, you should be able to: • Understand how predictive analytics is transforming all types of organizations • Explain how analytics supports retail companies • Understand how analytics can reduce crime rates and accidents • Explain the use of analytics in law enforcement and insurance companies • Understand how analytics can affect the future of education
		Unit – 5: Case studies and solutions (Duration: 15 Minutes)	
		Overview	This unit covers real case studies and solutions of the adoption of business analytics across theworld
		Learning objectives	After completing this unit, you should be able to: • Understand the importance of business analytics • Comprehend how big data and analytics can help in understanding consumer / customerbehavior • Explain how analytics can help manage assets • Understand how analytics can help combat fraud • Explain how analytics can help us to understand social sentiments
MODULE II – Business Analytics Foundations			
	Course I – Business Intelligence and Analytics 101 (Duration: 01 Hour)		
		Course Introduction: (Duration: 05 Minutes)	
		Business Intelligence and Analytics 101 (Duration: 01 Hour)	
		Overview	This course provides a collection of resources designed for participants to become familiar with business intelligence (BI) and analytics concepts. Participants will review materials to introducethemselves to terminology and practical business use cases for a high level understanding of BIand analytics. The course includes a pre-assessment for participants to measure their understanding of the content before taking the course, and a post-assessment for participants to gauge their learning after reviewing the materials
		Learning objectives	After completing this course, you should be able to: • Explain what is analytics • Define various types of analytics • Demonstrate how to apply analytics • Describe business intelligence • Demonstrate how to apply business intelligence
MODULE III – Predictive Analytics Modeler			

	Course I – Introduction to A Predictive Analytics Platform & Data Mining (Duration: 27.2 Hours)		
		Course Introduction: (Duration: 10 Minutes)	
		Unit – 1: Introduction to Data Mining (Duration: 01 Hour)	
		Overview	In this unit, you will learn about data mining and its applications
		Learning objectives	After completing this unit, you should be able to: • List two applications of data mining • Explain the stages of the CRISP-DM process model • Describe successful data-mining projects and the reasons why projects fail • Describe the skills needed for data mining
		Exercise 1 – The ACME business case: Modeling response for a campaign (Duration: 01 Hour)	
		Overview	In this exercise, you will learn how to apply data mining
		Learning objectives	After completing this exercise, you should be able to: • Understand data mining • Describe how to apply data mining in different scenarios
		Unit – 2: Working with IBM SPSS Modeler (Duration: 01 Hour)	
		Overview	In this unit, you will learn about objects such as streams and nodes and you will acquireexperience with the software.
		Learning objectives	After completing this exercise, you should be able to: • Describe the MODELER user-interface • Work with nodes • Run a stream or a part of a stream • Open and save a stream • Use the online Help
		Exercise 1 – Work with IBM SPSS Modeler (Duration: 45 Minutes)	
		Overview	In this exercise, you will learn about MODELER's user-interface to create streams
		Learning objectives	After completing this exercise, you should be able to: • Create streams • Change streams • Generate a select node from the Table output
		Unit – 3: Creating a data-mining project (Duration: 01 Hour)	
		Overview	In this unit you will learn about building a model and then applying that model to future cases ofa data-mining project.
		Learning objectives	After completing this unit, you should be able to: • Explain the basic framework of a data-mining project • Build a model • Deploy a model
		Exercise 1 – Create a data mining project to predict response in an ACME campaign (Duration: 45 Minutes)	
		Overview	In this exercise, you will build a model using data of the test mailing. This model (hopefully) identifies groups with high response rates. You will then use this model to select the groups withhigh response rates in the rest of the customer database (only these groups will be included in the actual mailing for the XL Original Orange Baseball Cap).
		Learning objectives	After completing this exercise, you should be able to: • Build a model using historical data • Deploy the model
		Unit – 4: Collecting initial data (Duration: 01 Hour)	

		Overview	In this unit, you will learn how to collect initial data. You will also learn how to describe data.
		Learning objectives	After completing this exercise, you should be able to: • Explain the concepts of data structure, unit of analysis, field storage and field measurement level • Import Microsoft Excel files • Import text files • Import from databases • Export data to various formats
		Exercise 1 – Collect initial data for ACME (Duration: 45 Minutes)	
		Overview	In this exercise you will learn how to collect initial data for ACME
		Learning objectives	After completing this exercise, you should be able to: • Collect initial data for ACME
		Unit – 5: Understanding your data (Duration: 01 Hour)	
		Overview	In this unit, you will learn how to explore data and assess it's quality.
		Learning objectives	After completing this exercise, you should be able to: • Audit the data • Explain how to check for invalid values • Take action for invalid values • Explain how to define blanks
		Exercise 1 – Understand the ACME data (Duration: 01 Hour)	
		Overview	In this exercise, you will learn how to understand the ACME data
		Learning objectives	After completing this exercise, you should be able to: • Import and examine data
		Unit – 6: Setting the unit of analysis (Duration: 01 Hour)	
		Overview	In this exercise, you will learn how to set unit of analysis in three different methods
		Learning objectives	After completing this exercise, you should be able to: • Set the unit of analysis by removing duplicate records • Set the unit of analysis by aggregating records • Set the unit of analysis by expanding a categorical field into a series of flag fields
		Exercise 1 – Set the unit of analysis for the ACME data (Duration: 45 Minutes)	
		Overview	In this exercise, you will learn how to set the unit of analysis for the ACME data.
		Learning objectives	After completing this exercise, you should be able to: • Cleanse data by removing duplicate records • Expand a categorical field into a series of flag fields
		Unit – 7: Integrating data (Duration: 01 Hour)	
		Overview	In this exercise you will learn how to combine different datasets into a single dataset foranalysis.
		Learning objectives	After completing this exercise, you should be able to: • Integrate data by appending records from multiple datasets • Integrate data by merging fields from multiple datasets • Sample records
		Exercise 1 – Integrate ACME data (Duration: 45 Minutes)	

		Overview	In this exercise, you will learn how to combine a number of datasets into a single dataset as apreparation for analysis and modeling.
		Learning objectives	After completing this exercise, you should be able to: • Append records from two datasets • Merge fields from different datasets • Enrich a dataset with aggregated data • Sample records
		Unit – 8: Deriving and reclassifying fields (Duration: 01 Hour)	
		Overview	In this unit, you will learn how to construct the final dataset for modeling by cleansing andenriching your data.
		Learning objectives	After completing this exercise, you should be able to: • Use the Control Language for Expression Manipulation (CLEM) • Derive new fields & Reclassify field values
		Exercise 1 – Derive and reclassify fields for the ACME data (Duration: 45 Minutes)	
		Overview	In this exercise, you will learn how to cleanse and enrich a dataset to build models
		Learning objectives	After completing this exercise, you should be able to: • Cleanse data and derive fields for modeling • Cleanse data and reclassify fields for modeling
		Unit – 9: Identifying relationships (Duration: 01 Hour)	
		Overview	In this unit, you will learn methods used to examine the relationship between two fields
		Learning objectives	After completing this exercise, you should be able to: • Examine the relationship between two categorical fields • Examine the relationship between a categorical field and a continuous field • Examine the relationship between two continuous fields
		Exercise 1 – Identify relationships in the ACME data (Duration: 45 Minutes)	
		Overview	In this exercise you will learn how to assess relationships and determine its strength by doing ademo
		Learning objectives	After completing this exercise, you should be able to: • Assess the relationship between churn and handset • Assess the relationship between churn and number of dropped calls • Assess the relationship between number of products and revenues
		Unit – 10: Introduction to modeling (Duration: 01 Hour)	
		Overview	In this unit, you will learn about the modeling stage of the CRISP-DM process model.
		Learning objectives	After completing this exercise, you should be able to: • List three modeling objectives • Use a classification model • Use a segmentation model
		Exercise 1 – Predict response in ACME campaigns (Duration: 45 Minutes)	
		Overview	In this exercise you will learn about classification and segmentation using a synthetic datasetfrom a telecommunications firm
		Learning objectives	After completing this exercise, you should be able to: • Predict churn by running a CHAID model • Predict churn by running a Neural Net model • Compare the accuracy of these models • Find groups of similar customers, based on usage.
	Course II – Advanced data preparation using IBM SPSS Modeler (Duration: 13.75 Hours)		

		Course Introduction: (Duration: 10 Minutes)	
		Unit – 1: Using functions to cleanse and enrich data (Duration: 01 Hour)	
		Overview	In this unit, you will learn how to use various different kinds of functions
		Learning objectives	After completing this unit, you should be able to: • Use date functions • Use conversion functions • Use string functions • Use statistical functions • Use missing value functions
		Exercise 1 – Using functions to clean and enrich travel agency data (Duration: 30 Minutes)	
		Overview	In this exercise you will work with data about customers and their holiday destinations. You willderive new fields to answer questions such as "What is the mean age of the customers?", "What was the most popular month to travel?", "What was the most popular destination?", and"What was the mean amount of money spent?"
		Learning objectives	After completing this exercise, you should be able to: • Use functions to clean and enrich travel data
		Unit – 2: Using additional field transformations (Duration: 01 Hour)	
		Overview	In this unit, you will learn about using additional field transformations.
		Learning objectives	After completing this exercise, you should be able to: • Replace values with the Filler node • Recode continuous fields with the Binning node • Change a field's distribution with the Transform node
		Exercise 1 – Use additional field transformations to prepare travel agency data for modeling (Duration: 01 Hour)	
		Overview	In this exercise, you will use additional field transformations to prepare travel agency data formodeling
		Learning objectives	After completing this exercise, you should be able to: • Use additional field transformations to prepare travel agency data
		Unit – 3: Working with sequence data (Duration: 01 Hour)	
		Overview	In this unit, you will learn how to work with sequenced data.
		Learning objectives	After completing this exercise, you should be able to: • Use cross-record functions • Count an event across records • Expand a continuous field into a series of continuous fields with the Restructure node • Use geospatial and time data with the Space-Time-Boxes node
		Exercise 1 – Prepare sequence data of a travel agency for analysis (Duration: 45 Minutes)	
		Overview	In this exercise you will work with a dataset storing customers and their holidays. You will derivenew fields to answer questions such as "What is the mean age of the customers?", "What was the most popular country?" and so forth.
		Learning objectives	After completing this exercise, you should be able to: • Prepare sequence data of a travel agency for analysis.
		Exercise 2 – Determine the availability or taxis (Duration: 01 Hour)	
		Overview	In this exercise, you will learn how to determine the availability of taxis.
		Learning objectives	After completing this exercise, you should be able to: • Determine the availability of taxis

		Unit – 4: Sampling, partitioning, and balancing data (Duration: 01 Hour)	
		Overview	In this unit, you will learn how to use the Sample node and various reasons for samplingrecords
		Learning objectives	After completing this exercise, you should be able to: • Use the Sample node to draw simple and complex samples • Partition the data into a training and a testing set • Reduce or boost the number of records
		Exercise 1 – Sample, partition, and balance house property data (Duration: 45 Minutes)	
		Overview	In this exercise, you will sample, partition, and balance charity data
		Learning objectives	After completing this exercise, you should be able to: • Sample, partition, and balance charity data
		Unit – 5: Improving efficiency (Duration: 01 Hour)	
		Overview	In this exercise, you will learn how to work with SQL pushback, Set Globals node andparameters to optimize efficiency.
		Learning objectives	After completing this exercise, you should be able to: • Use database scalability by SQL pushback • Use the Data Audit node to process outliers and missing values • Use the Set Globals node • Use parameters • Use looping and conditional execution
		Exercise 1 – Improve efficiency with travel agency data (Duration: 45 Minutes)	
		Overview	In this exercise you will process outliers, extremes and missing values, using the Data Audit node. You will use the Set Globals node to replace missing values, and you will be introduced to automation by using parameters and looping.
		Learning objectives	After completing this exercise, you should be able to: • Use the Data Audit node to process outliers, extremes and missing values • Compute standardized scores using globals • Use parameters • Create a loop through values
		Course III – Predictive Analytics with IBM Watson Studio (Duration: 12 Hours)	
		Course Introduction: (Duration: 15 Minutes)	
		Unit – 1: Introduction to IBM Watson Studio (Duration: 30 Minutes)	
		Overview	This unit provides a high level overview of IBM Watson Studio, its components, key applicationsand the value added by the IBM offering
		Learning objectives	After completing this unit, you should be able to: • Describe Watson Studio. • Identify industry use cases. • List Watson Studio offerings & Create Watson Studio projects. • Describe Watson Studio and Spark environment. • Describe Watson Studio and Object Storage. • Explain Watson Studio high availability considerations. • Prepare and analyze data & Use Jupyter notebooks.
		Exercise 1 – Getting started with Watson Studio (Duration: 01 Hour 30 Minutes)	
		Overview	This exercise introduces you to the basic tasks that you perform when you use Watson Studio

		Learning objectives	• Create a Watson Studio project. • Manage the project & Assign collaborators. • Load a data set into the project's object store. • Manage Cloud Object Storage. • Analyze data by using Watson Studio. • Use scikit-learn for linear regression.
		Unit – 2: Introduction to IBM Watson Machine Learning (Duration: 01 Hour)	
		Overview	This unit provides an overview of the IBM Watson Machine Learning service available on IBMCloud. It explains the process of preparing the data before it is provided to machine learning algorithms. This unit describes the use of the Data Refinary tool to cleanse and shape tabular data with a graphical flow editor.
		Learning objectives	After completing this unit, you should be able to: • Describe data preparation before feeding into machine learning algorithms. • Describe Watson Machine Learning features and capabilities. • Describe the Data Refinery tool. • List the data formats and sizes that Data Refinery operates on. • List the Data Refinery features and explain each feature.
		Exercise 1 – Getting started with Watson Studio (Duration: 01 Hour)	
		Overview	In the first part, this exercise introduces you to the basic tasks of refining data with Data Refinery on Watson Studio. In the second part, it introduces you to Auto AI on Watson Studio formachine learning models creation.
		Learning objectives	After completing this exercise, you should be able to: • Import data into Data Refinery in an existing project. • Review the data with the Profile and Visualizations features • Refine the data by that use various shaping operations. • Run a job for the Data Refinery flow. • Create a model by using the Auto AI graphical tool in Watson Studio.
		Unit – 3: Introduction to neural networks and deep learning (Duration: 01 Hour 90 Minutes)	
		Overview	This unit introduces machine learning models that are inspired by the structure of the human brain, which is known as neural networks. Then, this unit provides an overview to deep learning,which is a machine learning technique that uses neural networks to learn.
		Learning objectives	After completing this unit, you should be able to: • Describe neural networks. • Explain the concepts of Perceptron and back propagation. • Explain what an activation function is and identify the most common examples. • Articulate the difference between deep and shallow neural networks. • List the reasons for the current deep learning emergence. • Identify the basic architectures of deep neural networks and their applications. • Describe the functions of IBM Watson Studio Neural Network Modeler.
		Exercise 1 – Exploring deep learning and neural network modeling with Watson Studio (Duration: 01 Hour 30 Minutes)	
		Overview	This exercise guides you step-by-step through the design of a deep learning neural network architecture based on a sample flow that is provided to you. You create your own convolutionalneural network with Watson Studio.
		Learning objectives	After completing this exercise, you should be able to:

			• Build a neural network to recognize handwritten digits. • Create a neural network design flow by using the neural network modeler. • Train models with experiment builder.
		Unit – 4: IBM Watson Studio Jobs (Duration: 30 Minutes)	
		Overview	This unit describes how to use IBM Watson Studio Jobs to run data operations assets such asnotebooks and Data Refinery flows. This unit explains how to create and run jobs from a DataRefinery flow and a notebook.
		Learning objectives	After completing this unit, you should be able to: • Explain the purpose and function of jobs. • Explain how to create jobs by using a project, Data Refinery flow, or a Notebook. • Describe how to view, edit, and run jobs. • Use Watson Studio Jobs on a practical use case to automate model training anddeployment.
		Exercise 1 – Automating data preparation, model training, and deployment with Watson Studio jobs (Duration: 01 Hour 30 Minutes)	
		Overview	This exercise demonstrates how to use Watson Studio jobs to run an end to end scenario in adata science project. You use previously developed artifacts to create Watson Studio jobs to prepare your data, train the model, deploy the trained model, and score your data.
		Learning objectives	After completing this exercise, you should be able to: • Create data preparation jobs from Data Refinery flows. • Create jobs from notebooks to train, evaluate, and deploy models. • Create jobs from notebooks to score your data.

Course Title	Cryptography & Network Security (Professional Elective Course – II)					B.Tech. VI Sem (R20UG) AI&ML		
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
2039604	**PEC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 90 Min					**End Exam Duration: 3Hrs**			

Course Objectives:

- Extensive, thorough and significant understanding of the concepts, issues, principles and theories of computer network security
- Identifying the suitable points for applying security features for network traffic
- Understanding the various cryptographic algorithms and implementation of the same.
- Understanding the various attacks, security mechanisms and services.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Identify information security goals, classical encryption techniques and acquire fundamental knowledge on the concepts of finite fields and number theory.
CO 2	Understand, compare and apply different encryption and decryption techniques to solve problems related to confidentiality and authentication.
CO 3	Apply the knowledge of cryptographic checksums and evaluate the performance of different message digest algorithms for verifying the integrity of varying message sizes.
CO 4	Apply different digital signature algorithms to achieve authentication and create secure applications.
CO 5	Apply network security basics, analyze different attacks on networks and evaluate the performance of firewalls and security protocols like SSL, IPSec, and PGP.
CO 6	Apply the knowledge of cryptographic utilities and authentication mechanisms to design secure applications

UNIT – I

Computer Security concepts, The OSI Security Architecture, Security attacks, Security services and Security mechanisms, A model for Network Security, Classical encryption techniques-symmetric cipher model, substitution ciphers, transposition ciphers, Steganography, Modern Stream ciphers.

UNIT – II

Modern Block Ciphers: Block ciphers principles, Data encryption standard (DES), Strength of DES, Block cipher modes of operations, AES, RC4.

Introduction to Number theory: Integer Arithmetic, Modular Arithmetic, Linear Congruence, Algebraic Structures, GF(2n) Fields, Primes, Factorization, Chinese remainder Theorem, Quadratic Congruence.

UNIT – III

Public-key cryptography: Principles of public-key cryptography, RSA Algorithm, Diffie-Hellman Key Exchange, EL Gamal cryptographic system.

Cryptographic Hash functions: Applications of Cryptographic Hash functions, Requirements and security, Hash functions based on Cipher Block Chaining, Secure Hash Algorithm (SHA).

UNIT – IV

Message Authentication Codes: Message authentication Requirements, Message authentication functions, Message authentication codes, security of MACs, HMAC.

Digital Signatures: Digital Signatures, Schnorr Digital Signature Scheme, Digital SignatureStandard.

UNIT – V

User Authentication: Remote user Authentication Principles, Kerberos

Electronic mail security: Pretty Good Privacy (PGP), S/MIME Worms, Viruses, Firewalls.

Text Books:

1. Cryptography and network Security by Fourth edition, Stallings, PHI/Pearson
2. Cryptography & Network Security by Behrouz A. Forouzan, TMH.
3. Network Security: The complete reference by Robert Bragg, Mark Rhodes, TMH
4. Computer Security Basics by Rick Lehtinen, Deborah Russell & G.T. Gangemi Sr., SPDO'REILLY.

Reference Books:

1. Cryptography and network Security by Atul Kahate, 4^{th} Edition, Tata McGraw Hill
2. Understanding Cryptography, Christof Paar. Jan Pelzl, Springer.
3. Introduction to Modern Cryptography, Jonathan Katz, Yehuda Lindell, 2^{nd} Edition, CRC

<table>
<tr><td rowspan="1">Course Title</td><td colspan="4">Cloud Computing
(Professional Elective Course – II)</td><td colspan="4">B.Tech. VI Sem (R20UG) AI&ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039605</td><td rowspan="2">PEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- To explain the cloud paradigms.
- To introduce the various levels of services that can be achieved by cloud.
- To know about service providers of cloud.

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	Recall different computing paradigms
CO 2	Understand the evolution of cloud computing paradigm and its architecture, and characterizing different cloud deployment models.
CO 3	Explain service models and Virtualization.
CO 4	Understand programming models and Software Development in Cloud Computing.
CO 5	Identify the Data Center environment and service providers in cloud computing.

UNIT – I

Computing Paradigms: High-Performance Computing, Parallel Computing, Distributed Computing, Cluster Computing, Grid Computing, Cloud Computing, Biocomputing, Mobile Computing, Quantum Computing, Optical Computing, Nano computing, Network Computing.

Cloud Computing Fundamentals: Motivation for Cloud Computing: The Need for Cloud Computing. Defining Cloud Computing: NIST Definition of Cloud Computing, Computing Is a Service, Cloud Computing Is a Platform. Principles of Cloud computing: Five Essential Characteristics, Four Cloud Deployment Models, Three Service Offering Models, Cloud Ecosystem, Requirements for Cloud Services, Cloud Application, Benefits and Drawbacks.

UNIT – II

Cloud Computing Architecture and Management: Cloud Architecture, Anatomy of the Cloud, Network Connectivity in Cloud Computing, Applications on the Cloud, Managing the Cloud, Migrating Application to Cloud.

Cloud Deployment Models: Private Cloud, Public Cloud, Community Cloud, Hybrid Cloud.

UNIT – III

Cloud Service Models: Infrastructure as a Service, Platform as a Service, Software as a Service,Other Cloud Service Models.

Virtualization: introduction, Virtualization opportunities, Approaches to virtualization,Hypervisors, From virtualization to cloud computing.

UNIT – IV

Programming Models in Cloud: Cloud Application Development Platforms: Windows Azure,Google App Engine, Force.com, Manjrasoft Aneka.

Software Development in Cloud: Introduction, Different perspectives on SaaS development,New challenges, Cloud aware software development using PaaS technology

UNIT – V

Networking for Cloud Computing: Introduction, Overview of Data Center Environment,Networking Issues in Data Centers. **Cloud Service Providers:** Introduction, EMC, Google, Amazon Web Services, Microsoft, IBM,Salesforce, Rackspace.

Text Books:

1. Barrie Sosinsky, Cloud Computing Bible, Wiley-India, 2010.
2. Nikos Antonopoulos, Lee Gillam, Cloud Computing: Principles, Systems andApplications, Springer, 2012.
3. K. Chandrasekaran, Essentials of Cloud Computing, CRC Press, 2015.
4. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, CloudComputing: Principles and Paradigms, Wiley, 2011

Reference Books:

1. Cloud Computing: A Practical Approach, Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, TataMcGraw Hill.
2. Cloud Computing Theory and Practice: Dan C. Marinescu, Elsevier.
3. Cloud Computing Bible, Barrie Sosinsky, Wiley Publishing.
4. Cloud Computing and Virutualization, Dac-Nhuong Le, Raghavendra Kumar,Gia Nhu Nguyen, Jyir Moy Chatterjee, Wiley.

<table>
<tr><td>Course Title</td><td colspan="4">Computational Intelligence
(Professional Elective Course – II)</td><td colspan="3">B.Tech. VI Sem (R20UG) AI&ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039606</td><td rowspan="2">PEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- Computational Intelligence is the successor to Artificial Intelligence
- Offering special benefits in its applications in certain areas like Classification, Regression, Pattern Matching, Control, Robotics, Data Mining etc.
- To introduce the basic tools and techniques in Computational Intelligence such as Neural Networks
- Understands the concepts of Genetic Algorithms from an application perspective to the students
- Understand the fuzzy logic concepts and build the fuzzy logic systems

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Provide a basic exposition to the goals and methods of Computational Intelligence
CO 2	Apply the Intelligent techniques for problem solving
CO 3	Understand and compare neural networks with other information processing methods.
CO 4	Understand the fuzzy logic concepts and build the fuzzy logic systems
CO 5	Apply fuzzy logic principles and thinking to deal with vulnerability and tackle real time issues.

UNIT – I

Introduction: Background and history of evolutionary computation, Behavioral Motivations for Fuzzy Logic, Myths and Applications areas of Computational Intelligence. Adaption, Self-organization and Evolution, Historical Views of Computational Intelligence, Adaption and Self-organization for Computational Intelligence, Ability to Generalize, Computational Intelligence and Soft Computing Vs Artificial Intelligence and Hard Computing.

UNIT – II

Review of evolutionary computation theory and Concepts: History of Evolutionary Computation, Evolution Computation Overview, Genetic algorithms, Evolutionary programming, Evolution strategies, genetic programming, and particle swarm optimization.

UNIT – III

Review of basic neural network theory and Concepts: Neural Network History, What Neural Networks are and Why they are useful, Neural Networks Components and Terminology, Neural Networks Topology, Neural Network Adaption, Comparing Neural Networks and Other information Processing Methods, Preprocessing and Post Processing.

UNIT – IV

Fuzzy Systems Concepts and Paradigms: Fuzzy sets and Fuzzy Logic, Theory of Fuzzy sets, Approximate Reasoning, Fuzzy Systems Implementations, Fuzzy Rule System Implementation.

UNIT – V

Computational Intelligence Implementations: Implementation Issues, Fuzzy Evolutionary Fuzzy Rule System Implementation, Best tools, Applying Computational Intelligence to Data Mining. Performance Metrics: General Issues, Percent Correct, Average Sum-squared Error.

Text Books:

1. Eberhart & Shi "Computational Intelligence - Concepts to Implementations

Reference Books:

1. Melanie Mitchell "Introduction to Genetic Algorithms"
2. Davis "Handbook of Genetic Algorithms"
3. Tom Mitchel - Machine Learning

Course Title	**Solid Waste Management**					**B.Tech CE VI Sem (R20)**		
CourseCode	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE104	**Open Elective (OEC II)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 1.5 Hrs						**End Exam Duration: 3 Hrs**		

Course Objectives:
To know the necessity of solid waste management
To study various strategies for the collection of solid waste
To understand various solid waste disposal methods
To understand how to categorize the Hazardous Wastes

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	Understand and identify the physical and chemical composition of solid waste.
CO 2	Understand the optimum route planning for transport of solid waste.
CO 3	Understand the techniques and methods used in transformation, conservation, and recovery of materials from solid wastes.
CO 4	Understand the design of waste disposal systems.
CO 5	Understand the sources and how to manage the different categories of Hazardous Wastes.

UNIT - I
Introduction to Solid Waste
Definition - Types of solid waste - sources of solid waste - Characteristics - properties of solid wastes - Sampling of Solid wastes - Elements of solid waste management

UNIT - II
Solid Waste Management
Solid waste generation - onsite handling - storage and processing - collection of solid wastes - Stationary container system and Hauled container systems - Route planning - transfer and transport.

UNIT - III
Resource and Energy Recovery
Processing techniques - materials recovery systems - Composting - types of composting - Problems with composing – Pyrolisis – Gasification - RDF - recovery of energy from conversion products - materials and energy recovery systems.

UNIT - IV
Landfills
Types and Construction of landfills - Design considerations - Life of landfills - Landfill Problems - Lining of landfills - Leachate pollution and control - Landfills reclamation.

UNIT - V
Hazardous Waste Management
Sources and characteristics - Effects on environment - Risk assessment - Disposal of hazardous wastes - Secured landfills, incineration - Biomedical waste disposal - E-waste management

Text Books:

1. Tchobanoglous G, Theisen H and Vigil SA 'Integrated Solid Waste Management, Engineering Principles and Management Issues' McGraw-Hill, 1993.
2. Vesilind PA, Worrell W and Reinhart D, 'Solid Waste Engineering' Brooks/Cole Thomson Learning Inc., 2002.

Reference Books:

1. CPHEEO Manual on Municipal Solid Waste Management - 2000
2. Qian X, Koerner RM and Gray DH, 'Geotechnical Aspects of Landfill Design and Construction' Prentice Hall, 2002.
3. Peavy, H.S, Rowe, D.R., and G. Tchobanoglous, 'Environmental Engineering', McGraw Hill Inc., New York, 1985.

<table>
<tr><td>Course Title</td><td colspan="5">Estimation and Costing</td><td colspan="3">B.Tech CE VI Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE105</td><td rowspan="2">Open Elective (OEC II)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 1.5 Hrs</td><td colspan="3">End Exam Duration: 3 Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
To attain basic knowledge on types of quantity estimation of structures different types of structures and estimate quantities of load bearing wall structures
To interpret the rates of different items of works involved in a construction activity.
To understand various types & conditions of contracts and related documentation
To know about various techniques of valuation of land and building properties
To get basic knowledge on various types of costing along with cost control and reduction techniques.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Estimate quantities of various types of load bearing wall structures.</td></tr>
<tr><td>CO 2</td><td colspan="8">Calculate the rates of different items of works involved in a construction activity.</td></tr>
<tr><td>CO 3</td><td colspan="8">Know different types of contract documents as per requirements of a project.</td></tr>
<tr><td>CO 4</td><td colspan="8">Do valuation of land and building properties.</td></tr>
<tr><td>CO 5</td><td colspan="8">Do costing of a product using various techniques.</td></tr>
</table>

UNIT-I

Introduction to the Estimation of Structures

Introduction, Different Item of Works – Units of Item of works– Types of Estimates – Methods of Estimates.

Quantity Estimation of Buildings

Estimation of Quantities in Buildings: Load Bearing Wall Structure of Single Room and Multi Room

UNIT – II

Rate Analysis

Rate Analysis of Different Item of Works: Earthwork Excavation – Mortars of Various Proportions(Cement and Lime)–Concrete with Various Proportions (Lime and Cement) – Brick Masonry – Stone Masonry – Pointing – Painting – Plastering.

UNIT – III

Contracts

Types of Contracts, Contract Document, Conditions of Contracts, Contract Procedure, Termination of Contracts, Specifications, Important Conditions of Contract, Arbitration and Tenders.

UNIT – IV

Valuation

Introduction, Technique of Valuation, Elements of Valuation and Factors Affecting Valuation, Methods of Valuation to the Land Property and Building Property, Mortgage.

UNIT – V

Costing

Fixed and variable cost, Product and Process Costing, Standard Costing, Cost estimation, Relevant Cost for decision making, Cost estimation, Cost control and Cost reduction techniques.

Text Books:

1. B N Dutta "Estimating and Costing in Civil Engineering", U B S Publishers Distributers Pvt. Limited, Noida.
2. "Standard Data Book – Vol.2", Andhra Pradesh Department of Standard Specifications,Amaravati.
3. Contracts and estimations by B.S.Patil, Universities.Press, Hyderabad
4. G.S. Birdie, Estimating and Costing, Danpatrai Publications, New Delhi, 2009
5. Riggs, J.L., Dedworth, Bedworth, D.B, Randhawa, S.U. Engineering Economics, McGraw Hill International Edition, 1996

Reference Books:

1. Dr. Roshan H Namavati "Professional Practice", The Lakhani Book Depot, Mumbai.
2. S C Rangwala "Estimating Costing and Valuation", Charotar Publishing House Pvt.Limited, Anand.
3. IS 1200 (Parts I to XXV–1974/ Method of Measurement of Building and Civil EngineeringWorks – B.I.S.)
4. M. Chakraborthi, Estimating Costing Specification and Valuation in Civil Engineering,23rd Edition, Laxmi Publications, New Delhi, 2010.

Course Title	Water Management					B.Tech CE VI Sem (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE106	**Open Elective (OEC II)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 1.5 Hrs						**End Exam Duration: 3 Hrs**		

Course Objectives:
To understand different watershed behavior
To be able to interpret runoff data and quantify erosion by using various modelling methods.
To understand land use classification and impact of land use changes on hydrological cycle parameters.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Know concept and need for watershed management.
CO 2	Aware on various causes of soil erosion and mitigation methods.
CO 3	Implement basic rain water harvesting methods.
CO 4	Understand artificial groundwater recharge methods.
CO 5	Understand the soil reclamation methods.

UNIT – I
Introduction
Concept of watershed, need for watershed management, concept of sustainable development, hydrology of small watersheds.

UNIT – II
Soil Erosion
Principles of soil erosion- causes of soil erosion, types of soil erosion, estimation of soil erosion from small watersheds, Control of soil erosion, methods of soil conservation – structural and non-structural measures.

UNIT – III
Water Harvesting
Principles of water harvesting, methods of rainwater harvesting, design of rainwater harvesting structures.

UNIT – IV
Ground Water Recharge
Artificial recharge of groundwater in small watersheds-, methods of artificial recharge.

UNIT – V
Reclamation of saline soils
Micro farming - biomass management on the farm.

Text Books:
1. Murthy, V.V.N. and M.K. Jha Land and Water Management, Kalyani Publishers, 2015
2. Watershed Management by Madan Mohan Das and M.D. Saikia, Prentice Hall of India, 2013.

3. Watershed Management Muthy, J. V. S., New Age International Publishers, 1998.

Reference Books:

1. Watershed Hydrology by P E Black, Prentice Hall Englewood Cliffs, 1991.
2. Watershed Hydrology by R Suresh, Standard Publishers and Distributors, Delhi, 2020

<table>
<tr><td>Course Title</td><td colspan="5">Energy Conversion Systems</td><td colspan="3">B. Tech. EEE
Open Elective - II</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE203</td><td rowspan="2">Open Elective (OEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 1Hr30M</td><td colspan="3">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn about energy conversion techniques, sources of electrical energy production and impact of energy conversion systems on environment.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand various energy conversion systems, fuel cells & batteries</td></tr>
<tr><td>CO 2</td><td colspan="8">Analyze solar and wind energy conversion process</td></tr>
<tr><td>CO 3</td><td colspan="8">Illustrate Ocean Energy Conversion systems</td></tr>
<tr><td>CO 4</td><td colspan="8">Explain the environmental effects of Energy Conversion Systems.</td></tr>
</table>

UNIT I

Photo Voltaic Power Generation: Spectral distribution of energy in solar radiation, solar cell configurations, voltage developed by solar cell, photo current and load current, practical solar cell performance, test specifications for PV systems.

UNIT II

Wind Energy Conversion: Power from wind, properties of air and wind, types of wind Turbines, operating characteristics.

UNIT III

Tidal Power Station: Tides and Tidal power stations - modes of operation of Tidal project - Turbines and Generators for Tidal Power generation.

Ocean Thermal Energy Conversion: Types of ocean thermal energy conversion systems, Application of OTEC systems examples.

UNIT IV

Miscellaneous Energy Conversion Systems: Biomass conversion, Geothermal energy, Thermo electric energy conversion: Seebeck effect, Peltier and Thomson effects and their coefficients – Thermo-Electric Generator – Peltier Cooling

UNIT V

Fuel Cells & Batteries: Introduction - principles of EMF generation - description of fuel cells **-** Batteries, Description of batteries, Battery applications for large power.

Environmental Effects: Environmental Effects of Energy Conversion Systems, Pollution from coal and preventive measures - steam stations and pollution - pollution free energy systems.

Text Books

1. "Energy conversion systems" by Rakosh das Begamudre, New age international Private Ltd., publishers, 1st Edition, 2000.
2. "Renewable Energy Resources" by John Twidell and Tony Weir, CRC Press (Taylor & Francis).

<table>
<tr><td>Course Title</td><td colspan="5">Smart Grid</td><td colspan="3">B. Tech. EEE
Open Elective - II</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE204</td><td rowspan="2">Open Elective Course (OEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 1Hr30M</td><td colspan="3">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The student is able to learn fundamentals, Architecture and analysis of smart grid with communication, networking and measuring technologies involved in it.</td></tr>
<tr><td colspan="9">On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the features, fundamental components and architecture of smart grid</td></tr>
<tr><td>CO 2</td><td colspan="8">Explain information, communication and networking technologies involved with the smart grid</td></tr>
<tr><td>CO 3</td><td colspan="8">Explain operation and importance of PMU, WAMPS and smart storage systems in smart grid</td></tr>
<tr><td>CO 4</td><td colspan="8">Analyze Microgrid with various concepts and challenges in future</td></tr>
</table>

UNIT-1

Introduction to Smart Grid: Working definitions of Smart Grid and Associated Concepts – Need of Smart Grid – Smart Grid Functions – Opportunities & Barriers of Smart Grid - Conventional Power Grid and Smart Grid -Concept of Resilient & Self-Healing Grid.

UNIT-II

Smart Grid Architecture: Components and Architecture of Smart Grid – Review of Proposed Architectures for Smart Grid – The Fundamental Component of Smart Grid Designs – Transmission Automation – Distribution Automation –Renewable Integration.

UNIT-III

Information and Communication Technology: Smart sensors, Wired and wireless communication Technology, Network Structures (**HAN, LAN, NAN, WAN**), Introduction to Smart Meters – Advanced Metering Infrastructure (AMI).

UNIT-IV

Smart Grid Technologies: Geographic Information System (GIS) - Intelligent Electronic Devices (IED) - Smart storage like Battery- SMES - Pumped Hydro - Compressed Air Energy Storage - Wide Area Measurement System (WAMS) – SCADA - Phase Measurement Unit (PMU).

UNIT – V

Micro grids and Distributed Energy Resources: Concept of micro grid, need & application of micro grid, formation of micro grid, Issues of interconnection, protection & control of micro grid, Plastic & Organic solar cells, thin film solar cells, Variable speed wind generators, and fuel cells.

Text Books

1. Janaka Ekanayake, Kithsir iLiyanage, Jian zhong. Wu, Akihiko Yokoyama, Nick Jenkins, "Smart Grid: Technology and Applications"- Wiley, 2012.
2. Stuart Borlase, Smart Grids, Infrastructure, Technology and Solutions, CRC Press, 1e,2013.
3. James Momoh, "Smart Grid: Fundamentals of Design and Analysis"- Wiley, IEEE Press, 2012.

Reference Books

1. A.G. Phadke and J.S. Thorp, "Synchronized Phasor Measurements and their Applications", Springer Edition, 2e, 2017.
2. James Northcote, Green, Robert G. Wilson "Control and Automation of Electric Power Distribution Systems (Power Engineering)", CRC Press.
3. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability", Artech House Publishers July 2011.
4. 4. Clark W Gellings, "The Smart Grid, Enabling Energy Efficiency and Demand Side Response"- CRC Press, 2009.

<table>
<tr><td>Course Title</td><td colspan="4">Automotive Electronics, Sensors & Drives</td><td colspan="3">B.Tech ME VI Sem</td></tr>
<tr><td rowspan="1">Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE306</td><td rowspan="2">OEC-II</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

. The objectives of this course are to

- Explain the use of electronics in the automobile.
- Explain the importance of various types of sensors and actuators in automotive electroni
- Demonstrate the various control elements in Engine Management system.
- Familiarize with Vehicle management systems
- Identify various electronic and the instrumentation systems used in automobile

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Obtain an overview of automotive components, like sensors, actuators, communication protocols and safety systems employed in today’s automotive industry.
CO 2	Interface automotive sensors and actuators with microcontrollers.
CO 3	Know, the various display devices that are used in automobiles
CO 4	Identify the elements in the engine management and vehicle management system.
CO 5	Summarize an overview of automotive components, like sensors, actuators, communication protocols and safety systems employed in today’s automotive industry.

UNIT - I

Introduction to microcomputer

Introduction to microcomputer: Microcomputer: Buses, memory, timing, CPU registers; Microprocessor architecture: Initialization, operation codes, program counter, branch and jump instructions, subroutine. Analog to digital converters and Digital to analog converters, sampling, polling and interrupts, digital filters, lookup table.

UNIT - II

Sensors and actuators

Sensors and actuators: Speed sensors, Pressure sensors: Manifold Absolute Pressure sensor, knock sensor, Temperature sensors: Coolant and Exhaust gas temperature, Exhaust Oxygen level sensor, Position sensors: Throttle position sensor, accelerator pedal position sensor and crankshaft position sensor, Air mass flow sensor. Solenoids, stepper motors and relays.

UNIT - III

Electronic engine management system

Electronic engine management system: Electronic engine control: Input, output and control strategies, electronic fuel control system, fuel control modes: open loop and closed loop control at various modes, EGR control, Electronic ignition systems – Spark advance correction schemes, fuel injection timing control.

UNIT - IV

Electronic vehicle management system

Electronic vehicle management system: Cruise control system, Antilock braking system, electronic suspension system, electronic steering control, traction control system, Transmission control, Safety: Airbags, collision avoiding system, low tire pressure warning system.

UNIT - V

Automotive instrumentation system

Automotive instrumentation system: Input and output signal conversion, multiplexing, fuel quantity measurement, coolant temperature and oil pressure measurement, display devices- LED, LCD, VFD and CRT, Onboard diagnostics(OBD), OBD-II, off board diagnostics.

Text Books:

1. Understanding Automotive Electronics, William B Ribbens, Newne Butterworth-Heinermann, 6th edition 2003.

2. Crouse W H, Automobile Elctrical Equipment, McGraw Hill Book Co.Inc, Newyork 2005.

Reference Books:

1. Bechhold “Understanding Automotive Electronics”, SAE, 1998.

2. Robert Bosch “Automotive Hand Book”, SAE (5th Edition), 2000.

3. Tom Denton,”Automobile Electrical and Electronic Systems” 3rd edition- Edward Arnold, London - 2004.

4. Eric Chowanietz - ‘Automotive Electronics’ - SAE International USA – 1995.

Course Title	Robotics and Applications in Manufacturing					B.Tech ME VI Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE307	**OEC-II**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**--**	**3**	**40**	**60**	**100**
Mid Exam Duration: 90 Minutes					**End Exam Duration: 3Hrs**			

Course Objectives:

. The objectives of this course are to

- Learn the fundamental concepts of industrial robotic technology.
- Apply the basic mathematics to calculate kinematic and dynamic forces in robot manipulator.
- Understand the robot controlling and programming methods.
- Describe concept of robot vision system.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Illustrate the industrial applications of robot vision system.
CO 2	Use concepts of robot controlling systems.
CO 3	Evaluate D-H notations for simple robot manipulator.
CO 4	Define a robot and homogeneous transformations.
CO 5	Apply the concepts of robot.

UNIT - I

Fundamentals of Robots

Fundamentals of Robots: Introduction, definition, classification and history of robotics, robot characteristics and precision of motion, advantages, disadvantages and applications of robots. Introduction to matrix representation of a point in a space a vector in space, a frame in space, Homogeneous transformation matrices, representation of a pure translation, pure rotation about an axis.

UNIT - II

Kinematics of robot, Differential motions and Velocities

Kinematics of robot: Forward and inverse kinematics of robots- forward and inverse kinematic equations for position and orientation, Denavit-Hartenberg(D-H) representation of forward kinematic equations of robots, The inverse kinematic of robots, Degeneracy and Dexterity, simple problems with D-H representation.

Differential motions and Velocities: Introduction, differential relationship, Jacobian, differential motions of a frame-translations, rotation, rotating about a general axis, differential transformations of a frame. Differential changes between frames, differential motions of a robot and its hand frame, calculation of Jacobian, relation between Jacobian and the differential operator, Inverse Jacobian.

UNIT - III

Control of Manipulators

Control of Manipulators: Open- and Close-Loop Control, the manipulator control problem, linear control schemes, characteristics of second-order linear systems, linear second-order SISO model of a manipulator joint, joint actuators, partitioned PD control scheme, PID Control Scheme, computer Torque control, force control of robotic manipulators, description of force-control tasks, force control strategies, hybrid position/force control, impedance force/torque control.

UNIT - IV

Robot Vision

Robot Vision: Introduction, architecture of robotic vision system, image processing, image acquisition camera, image enhancement, image segmentation, imaging transformation, Camera transformation and calibrations, industrial applications of robot vision.

UNIT - V

Robot Application in Manufacturing

Robot Application In Manufacturing: Material Transfer - Material handling, loading and unloading - Process - spot and continuous arc welding & spray painting - Assembly and Inspection.

Text books:

1. Mikell P. Groover and Mitchell Weiss, Roger N. Nagel,NicholasG.Odrey , Industrial Robotics — McGraw Hill, 1986.
2. R K Mittal and I J Nagrath, Robotics and control, Illustrated Edition, Tata McGraw Hill India 2003.
3. John.J. Craig Addison, Introduction to Robotics: Mechanics and Control, Wesley, 1

Reference Books:

1. Saeed B. Niku, Introduction to Robotics – Analysis, System, Applications, 2nd Edition, John Wiley & Sons, 2010.
2. H. Asada and J.J.E. Slotine, Robot Analysis and Control, 1st Edition Wiley-Interscience, 1986.
3. Robert J. Schillin, Fundamentals of Robotics: Analysis and control, Prentice-Hall Of India Pvt. Limited, 1996.
4. Mohsen shahinpoor, A robot Engineering text book, Harper & Row Publishers,1987.

<table>
<tr><td>Course Title</td><td colspan="4">Sensors in Intelligent Manufacturing</td><td colspan="3">B.Tech ME VI Sem</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE308</td><td rowspan="2">OEC-II</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
. The objectives of this course are to
● Familiarize the sensors used in intelligent manufacturing.
● Illustrate sensors used in precision manufacturing and CNC machine tools.
● Explain sensors for monitoring of manufacturing systems.
● Outline advanced sensors used in intelligent manufacturing.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Classify various sensors used in intelligent manufacturing.</td></tr>
<tr><td>CO 2</td><td colspan="8">Summarize sensors used in computer integrated manufacturing and machine sensors.</td></tr>
<tr><td>CO 3</td><td colspan="8">Apply sensors used in precision manufacturing.</td></tr>
<tr><td>CO 4</td><td colspan="8">Identify reasons behind machinery faults.</td></tr>
<tr><td>CO 5</td><td colspan="8">Develop the Important role in making the products intelligent and highly automatic.</td></tr>
</table>

UNIT - I

Introduction

Introduction –Principles, classifications and characteristics of sensors – Electrical, magnetic, optical, acoustic, pneumatic, magnetic, electro-optical and vision sensors, role of sensors in intelligent manufacturing.

UNIT - II

Sensors and control in CIM and FMS:

Sensors and control in CIM and FMS: Design of CIM, decision support system for CIM, analysis of CIM, development of CIM strategy with sensors and control. FMS-Robot control with machine vision sensors-Architecture of robotic vision system, image processing, image acquisition, enhancement, segmentation, transformation, industrial application of robot vision, multi Sensor controlled robots, measurement of robot density, robot programming.

UNIT - III

Sensors in Precision Manufacturing:

Sensors in Precision Manufacturing: Testing of manufacturing components, principles and applications of digital Encoders, opto-electronic colour sensors, control applications in robotics. Sensors for CNC machine tools– linear, position and velocity sensors. Automatic identification techniques for shop floor control.

UNIT - IV

Sensors for Monitoring of Manufacturing Systems

Sensors for Monitoring of Manufacturing Systems: Principles – sensors for monitoring temperature, force, vibration and noise. Sensors to detect machinery faults.Selection of sensors and monitoring techniques.

UNIT - V

Smart / Intelligent sensors

Smart / Intelligent sensors: Integrated sensors, micro sensors, nano sensors. Manufacturing of semi conductor sensors.Fibre optic sensors – Fibre optic parameters, configurations, photoelectric sensor for long distance, sensor alignment techniques.

Text Books:

1. SabrieSoloman, Sensors and Control systems in Manufacturing, McGraw-Hill, 2/e, 2010.

2. H.K Tonshoff and I.Inasaki, Sensor Applications Vol 1: Sensors in Manufacturing, Wiley-VCH Publications, 2001.

Reference Books:

1. SabrieSoloman, Sensors Handbook, McGraw-Hill, 2/e, 2010.

2. MikellP.Groover, Mitchell Weiss, Roger N.Nagel, Nicholas G.Odrey, Industrial Robotics, Tata McGraw-Hill, 2008.

<table>
<tr><td>Course Title</td><td colspan="4">Non-Conventional Energy Sources</td><td colspan="3">B.Tech ME VI Sem</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE309</td><td rowspan="2">OEC-II</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:
. The objectives of this course are to

- To get exposure on solar radiation and its environmental impact to power production
- To know about the various collectors used for storing solar energy and their applications
- To learn about the wind energy and biomass and its economic aspects
- To know about geothermal, Ocean and Wave energy sources
- To know about direct energy conversion systems.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Determine the physics of solar radiation and its measurement techniques.
CO 2	Classify the solar energy collectors, methodologies of storing solar energy and
CO 3	Apply knowledge to develop Wind and Bio-energy systems.
CO 4	Categorize the Geothermal, Tidal, OTEC and hydelenergy, its mechanism of production and its applications.
CO 5	Illustrate the concepts of Direct Energy Conversion systems and their applications.

UNIT - I

Principles of Solar Radiation

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extra-terrestrial and terrestrial solar radiation, solar radiation on titled surfaces, instruments for measuring solar radiation and Sunshine Recorder, solar radiation data.

UNIT - II

Solar Energy Collection, Storage& Applications

Solar Energy Collection: Flat plate and concentrating collectors, classification of concentrating collectors, Advantages and disadvantages of concentrating collectors over Flat plate collectors
Solar Energy Storage: Different methods of solar Thermal Energy Storage Sensible, latent heat and stratified storage, solar ponds.
Applications of Solar Energy: solar water heating, solar distillation and drying, photovoltaic energy conversion.

UNIT – III

Wind Energy & Bio-Mass Energy

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria

Bio-Mass: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C. Engineoperation and economic aspects.

UNIT – IV

Geothermal Energy &Energy from Oceans

Geothermal sources, types of wells, methods of harnessing the energy, potential in India.

Ocean Energy: OTEC, Basic Principles utilization, setting of OTEC plants, thermodynamic cycles.

Tidal and Wave energy: Potential and conversion techniques, mini-hydel power plants

UNIT – V

Direct Energy Conversion Systems:

Need for DEC, principles of DEC, Thermo-electricpower generation – Basic Principle, materials, applications, MHD Power Generation-Principle, MHD systems, Fuel cells- principle and operation, types of fuel cells and their applications

Textbooks:

1. Mehmet Kanoglu, YunusA. Cengel, John M. Cimbala, Fundamental and Applications of Renewable Energy, First Edition, McGraw Hill, 2020
2. John Twidell and Tony Weir, Renewable Energy Resources, Third Edition, Routledge, 2015
3. G.D. Rai, Non-Conventional Energy Sources, Sixth Edition, Khanna Publications, 2017

Reference Books:

1. Wendell H. Wiser, Energy Resources: Occurrence,
2. Sukhatme S.P. Nayak.J. P, ‘Solar Energy – Principle of Thermal Storage and Collection”, Tata McGraw Hill, 2008.
3. Wei Tong, Wind Power Generation and Wind Turbine Design, WIT Press,2010.

Course Title	Supply Chain Management					B.Tech ME VI Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
20OE310	OEC-II	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	--	3	40	60	100
Mid Exam Duration: 90 Minutes					End Exam Duration: 3Hrs			

Course Objectives:

. The objectives of this course are to

- Explain the basics of supply chain management.
- Familiarize inventory management techniques and models to ensure EOQ batch size under risk management.
- Demonstrate various distribution strategies for shipment of products.
- Focus on evaluating of strategic alliance partners and understanding of RDBMS.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Apply the concepts of supply chain management for demand forecasting.
CO 2	Use of SCM and inventory management for procurement.
CO 3	Analyze the shipment activities and related issues.
CO 4	Build third party alliances.
CO 5	Adapt the RDBMS data for communications and analyzing future challenges and understand e-commerce strategies

UNIT - I

Understanding the supply chain

Understanding the supply chain: What is SCM? Why SCM? The Complexity, Key issues in SCM Logistics network - Introduction, Data Collection, Transportation, Ware house Management, Demand forecasting, Role of aggregate planning, MRP, ERP.

UNIT - II

Inventory management

Inventory management: Concepts of Materials Management, Economic lot size model, Effect of Demand uncertainly, Fixed order costs, Variable lead frames, Inventory under certainly & uncertainty.

UNIT - III

Distribution strategies

Distribution strategies: Introduction, Centralized vs Decentralized control, Direct shipment, Cross Docking, Push based vs Pull based supply chain.

UNIT - IV

Strategic alliances

Strategic alliances: Third party Logistics (3PL), Retailer – supplier relationship issues, requirements, success & failures, Distributor integration Types & issues.

UNIT - V

MIS & SCM

MIS & SCM: Relational Data Base Management (RDBMS), System Architecture, Communications, and Implementation of ERP, Decision support systems for SCM: e-Commerce strategies and world class supply chain management.

Text Books:

1. Sunil Chopra, Peter Meindl, Supply Chain Management: Strategy, Planning, and Operation, 4/e, Pearson, 2010.
2. David N. Burt, Donald W. Dobler , World Class Supply Management: The Key to Supply Chain Management, 2/e, McGraw-Hill/Irwin, 2003.
3. Nabil Abu el Ata, Rudolf Schmandt , Essentials of Supply chain management; Westland Publications. (2016),

Reference Books:

1. John Joseph Coyle, Edward J. Bardi, C. John Langley, The Management of Business Logistics: A Supply Chain Perspective, South-Western/Thomson Learning, 2003.
2. UpendraKachru ,Logistics and Supply Chain Management, Excel Books, 2009.
3. D. K .Agarwal**,** Supply Chain Management with efficient Logistics , MACMILAN 2019.

<table>
<tr><td>Course Title</td><td colspan="4">Introduction to VLSI</td><td colspan="3">Open Electives</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE403</td><td rowspan="2">OE</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>-</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90Min</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- To introduce the concepts of IC fabrication technologies.
- To understand scaling techniques of CMOS devices and their effects.
- To study the methods to design the basic Gate level designs and draws their corresponding Layouts.
- To provide basic idea of Subsystem design, PLDs and CMOS testing.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the operation of a MOS transistor down to the physical level.
CO 2	Implement various logic gates and circuits using MOS transistors.
CO 3	Analyze PLD and FPGA families for logic design.
CO 4	Analyze various CMOS testing schemes.

Unit-I

Introduction to VLSI: Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & Bi CMOS technologies- Oxidation, Lithography, Diffusion, Ion implantation, Metallization, Encapsulation.

Unit-II

Basic Electrical Properties: Basic Electrical Properties of MOS Circuits: Ids Vs Vds relationships, MOS transistor threshold Voltage, gm, gds, Figure of merit, Pass transistor, NMOS Inverter, CMOS Inverter analysis and Bi-CMOS Inverters.

Unit-III

VLSI Circuit Design Processes: VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, 2μ CMOS Design rules for wires, Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits, Limitations of Scaling.

Unit-IV

Subsystem Design: Basic circuit concepts: Sheet resistance, area capacitance and delay calculation, Subsystem Design, Shifters, Adders, ALUs, Multipliers, High Density Memory Elements.

Unit-V

Semiconductor IC Design and CMOS testing: PLAs, FPGAs, CPLDs, Standard Cells, ach. CMOS Testing, Need for testing, Test Principles, Design Strategies for test, Layout Design for improved Testability.

Text Books:

1. Kamran Eshraghian, Eshraghian Dougles and A. Pucknell, Essentials of VLSI circuits and systems, PHI, 2005 Edition.

2. Weste and Eshraghian, Principles of CMOS VLSI Design, Pearson Education, 1999.

Reference Books:

1. John .P. Uyemura, Introduction to VLSI Circuits and Systems, JohnWiley, 2003.
2. Wayne Wolf, Pearson Education, Modern VLSI Design, 3rd Edition, 1997.
3. S.M. SZE, VLSI Technology, 2nd Edition, TMH, 2003.

Course Title	Principles of communication systems					Open Electives		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
20OE404	OE	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	-	--	3	40	60	100
Mid Exam Duration: 90 Min					End Exam Duration: 3Hrs			

Course Objectives:

- To understand the Basics of Telecommunication Engineering.
- To introduce the Elements of Telecommunication systems.
- To provide Knowledge about various communication systems

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the fundamental concepts of Telecommunication Engineering.
CO 2	Understand use of different modulation techniques used in Analog and Digital Communication.
CO 3	Understand different Telecommunication systems like Satellite communication, Optical Fiber communication, Wireless communication, Mobile communication etc. and its applications.
CO 4	Compare and contrast advantages and limitations of various Telecommunication systems.

Unit I

Basics of Telecommunication Engineering: Definition of Telecommunication, Examples of telecommunications and evolution, various types of telecommunication systems such as telephone network, Radio broadcasting system, Computer networks, Internet.

Unit II

Basic Elements of Telecommunication systems General Block schematic of communication system, Communication channels, Analog versus digital communication systems, Need of modulation, Types of analog modulation such as AM and FM, Types of digital modulation such as Pulse code modulation, delta modulation, Continuous wave modulation such as ASK, FSK, PSK.

Unit III

Introduction to Optical Fiber Communication: Use of optical fiber in communication, Principle and working of OFC system, Block diagram, Types of optical fibers, various elements required in designing OFC system, Applications such as long distance transmission links, Computer communication networks.

Unit IV

Introduction to Satellite Communication: Use of satellite in telecommunications, Launching of Satellite from earth station, Types of satellite orbits, Classification of satellite according to applications, Satellite communication link block diagram.

Unit V

Some concepts in Wireless communications: Wireless Standards: Overview of 2G and 3G, 4G cellular standards, Multiple access schemes-FDMA, TDMA, CDMA and OFDM, Modulation schemes- BPSK, QPSK. GSM, Wi-Fi & Wi-Max, Bluetooth, Recent Trends/Developments.

Text Books:

1) Simon Haykin," Communication Systems", 4th Edition, John Wiley Publication.

2) George Kenndey, " Electronics Communication systems", 4th Edition

3) John G. Proakis," Digital Communication", Tata McGraw Hill

4) T . Prat, C.W. Bostian," Satellite Communication", Wielly Publication

Reference Books:

1. S. Rappaport," Wireless communication – Principles and Practice", Pearson Education.

2. John M. Senior,"Optical Fiber Communication Principles and Practice",, Pearson Education.

Course Title	Java Programming (Open Elective Course-II)				B. Tech VI Sem (R20) CSE		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE503	**OEC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 90 Mins					**End Exam Duration: 3Hrs**			

Course Objectives:

- To give the students a firm foundation on Java concepts like Primitive data types, Java control flow, Methods, Object-oriented programming, Core Java classes, packages and interfaces, multithreading.
- To provide the students with an understanding of Java applets, Abstract Window, Toolkit and exception handling.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Solve problems using object oriented approach and implement them using Java.
CO 2	Develop efficient programs with multitasking ability and handle exceptions.
CO 3	Develop user friendly interface.
CO 4	Create AWT components.

UNIT - I

Object Oriented Programming basics: Need for OOP paradigm, Principles of OOP concepts

Java Basics: History of Java, Java buzzwords, Simple java program, classes and objects – concepts of classes, objects, constructors, methods, introducing access control, **this** keyword, overloading methods and constructors.

UNIT - II

Inheritance: Hierarchical abstractions, Types of Inheritance, benefits of inheritance, **super** uses, using **final** with inheritance, polymorphism- method overriding, abstract classes.

Packages and Interfaces: Defining, Creating and Accessing a Package, importing packages, differences between classes and interfaces, defining an interface, implementing interface, applying interfaces, variables in interface and extending interfaces.

UNIT - III

Exception handling: Concepts of exception handling, exception hierarchy, usage of try, catch, throw, throws and finally, creating own exception sub classes.

UNIT - IV

Event Handling : Events, Event sources, Event classes, Event Listeners, The AWT class hierarchy, user interface components- Labels, Button, Scrollbars, Text Components, Check box, Choices, Layout manager types – Flow, Border, Grid, Card and Grid bag.

UNIT - V

Applets: Concepts of Applets, differences between applets and applications, life cycle of an Applet, creating applets, passing parameters to applets.

Swings: Icons and Labels, text fields, JButton class, Check boxes, Radio buttons, Combo boxes, and Tables.

Text Books:

1. Java; the complete reference, 7th editon, Herbert schildt, TMH.
2. Understanding OOP with Java, updated edition, T. Budd, Pearson Education.
3. An Introduction to programming and OO design using Java, J.Nino and F.A.Hosch, John wiley & sons.
4. An introduction to Java programming and object oriented application development, R.A. Johnson-Thomson.

Reference Books:

1. Core Java 2, Vol 1, Fundamentals, Cay.S.Horstmann and Gary Cornell, eighth Edition, Pearson Education.

2. Core Java 2, Vol 2, Advanced Features, Cay.S.Horstmann and Gary Cornell, eighth Edition, Pearson Education.

3. Object Oriented Programming through Java, P. Radha Krishna, University Press.

4. Java and Object-Oriented Programming Paradigm, Debasish Jana, PHI Learning Pvt. Ltd.

<table>
<tr><td>Course Title</td><td colspan="4">Web Designing
(Open Elective Course-II)</td><td colspan="3">B. Tech VI Sem (R20) CSE</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE504</td><td rowspan="2">OEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Mins</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- To learn the basic principles of Web page design.
- To learn the basic concepts of HTML.
- To introduce client side scripting with Java Script.
- To introduce the concepts of CSS and Web publishing.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Define the principle of Web page design and basics in web design.
CO 2	Visualize the basic concept of HTML and recognize the elements of HTML.
CO 3	Understand java Script and create static web pages.
CO 4	Introduce basics concept of CSS.
CO 5	Develop the concept of web publishing.

UNIT – I

Web Design Principles: Basic principles involved in developing a web site, Planning process, Five Golden rules of web designing, Designing navigation bar, Page design ,Home Page Layout, Design Concept.

Basics in Web Design: Brief History of Internet, What is World Wide Web, Why create a web site, Web Standards, Audience requirement.

UNIT – II

Introduction to HTML: What is HTML, HTML Documents, Basic structure of an HTML document, Creating an HTML document, Mark up Tags, Heading-Paragraphs, Line Breaks, HTML Tags.

Elements of HTML: Introduction to elements of HTML, Working with Text, Working with Lists, Tables and Frames, Working with Hyperlinks, Images and Multimedia, Working with Forms and controls.

UNIT – III

Java Script: Introduction, Basics of Java Script, Control Structures, Pop up Boxes, Functions, Arrays Events, Objects, Dynamic HTML.

UNIT – IV

Introduction to Cascading Style Sheets: Concept of CSS , Creating Style Sheet, CSS Properties, CSS Styling(Background, Text Format, Controlling Fonts) , Working with block elements and objects, Working with Lists and Tables, CSS Id and Class , Box Model(Introduction, Border properties, Padding Properties, Margin properties) , CSS Advanced(Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class, Navigation Bar, Image Sprites, Attribute sector), CSS Color , Creating page Layout and Site Designs.

UNIT – V

Introduction to Web Publishing or Hosting: Creating the Web Site, Saving the site, working on the web site, Creating web site structure, Creating Titles for web pages, Themes-Publishing web sites.

Text Books:

1. Creating a Web Page and Web Site College, 2002, Murray, Tom/Lynchburg.
2. HTML 5 in simple steps Dreamtech Press, Kogent Learning Solutions Inc.
3. A beginner's guide to HTML NCSA,14th May,2003.

Reference Books:

1. HTML, XHTML, and CSS Bible, 5ed, HTML, XHTML, and CSS Bible, 5ed, Wiley India.
2. Beginning HTML, XHTML, CSS, and JavaScript by John Duckett, Wiley India.
3. Beginning CSS: Cascading Style Sheets for Web Design by Ian Pouncey, Richard York, Wiley India.

<table>
<tr><td>Course Title</td><td colspan="5">MATHEMATICAL STATISTICS FOR DATA SCIENCE & DATA ANALYTICS (R20)</td><td colspan="3">B. Tech.
Open Elective-II</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE603</td><td rowspan="2">OEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 minutes</td><td colspan="4">End Exam Duration: 3Hours</td></tr>
<tr><td colspan="9">Course Objectives:
To help the students in getting a thorough understanding of the fundamentals of probabilities.
To help the students in getting a thorough understanding and usage of statistical techniques like testing of hypothesis.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand and calculate the measures of dispersion</td></tr>
<tr><td>CO 2</td><td colspan="8">Analyze probability concepts</td></tr>
<tr><td>CO 3</td><td colspan="8">Apply distributions in real life problems.</td></tr>
<tr><td>CO 4</td><td colspan="8">Justify hypothesis concepts</td></tr>
<tr><td>CO 5</td><td colspan="8">Estimate correlation and regression coefficients</td></tr>
</table>

UNIT I:
Introduction, Mean, Median, Mode, Skewness, Range

Learning Outcomes:
At the end of this unit, the student will be able to
- understand and calculate the measures of dispersion

UNIT II:
Probability Basics, Simple probabilities, Rule of addition, Rule of multiplication, Conditional Probability, Baye’s theorem.

Learning Outcomes:
At the end of this unit, the student will be able to
- analyze probability concepts

UNIT III:
Explaining basic concepts of Random Variables (Without Problems)- Probability Distributions: Binomial distribution**,** Poisson distribution**,** Normal distribution**,** Real life problems

Learning Outcomes:
At the end of this unit, the student will be able to
- apply distributions in real life problems.

UNIT IV:
Introduction, Hypothesis, Level of Significance, Type I and Type II errors, Confidence intervals for large Samples (only means and Proportions), Calculating sample size and power.

Learning Outcomes:

At the end of this unit, the student will be able to

- justify hypothesis concepts

UNIT V:
Introduction, Linear Regression, Correlation coefficient, Coefficient of determination, Root Mean Square Error.

Learning Outcomes:
At the end of this unit, the student will be able to

- estimate correlation and regression coefficients

Text Books:

1. Higher Engineering Mathematics, Dr. B.S. Grewal, Khanna Publishers-42 edition.
2. Statistical Methods by S.P.Gupta, S Chand Publications
3. Probability and Statistics for Engineers, Johnson, Fifth edition, Prentice Hall of India.
4. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Publications, 9^{th} edition-2013.

Reference Books:

1. Probability and Statistics by E. Rukmangadachari & E. Keshava Reddy, Pearson Publishers.
2. Probability and Statistics for Engineers and Scientists, Walpole and Myers, Seventh edition, Pearson Education Asia, 2002
3. An Introduction to Probability theory and its applications, William Feller
4. Engineering Mathematics by Srimanta Pal, Subodh C. Bhunia, Oxford University Press.

<table>
<tr><td>Course Title</td><td colspan="4">BASICS OF ELECTRICAL, MAGNETIC AND OPTOELECTRONIC MATERIALS</td><td colspan="4">OPEN ELECTIVE- II</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE608</td><td rowspan="2">BSC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End lab Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5"></td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

COURSE OBJECTIVES:

1.Students will be able to understand the fundamental concepts and applications of electrical, magnetic and optical properties of materials.
2.Apply a multi-disciplinary approach to plan, design, identify and address future needs of all the conventional and novel materials utilizing their properties for the society.

COURSE OUTCOMES: Upon completion of this course, the student will be able to:

CO1	**Obtain** knowledge about the electrical, magnetic and optoelectronic materials, their properties and applications
CO2	Successfully **apply** advanced concepts of materials engineering for the design, development and analysis of materials and devices.
CO3	**Develop** novel materials from the fundamental understanding of materials and apply them to societal needs.
CO4	**Analyze** the properties of superconductors.
CO5	**Identifies** the Engineering applications of electrical, magnetic and optoelectronic materials.

Unit – I: Electrical Materials

Introduction to electrical conduction–Dielectric constants – dielectric loss, dielectric breakdown, piezoelectricity and pyroelectricity.

Unit – II: Magnetic Materials

Introduction to dia, para, ferro, antiferro and ferri magnetism –Hysteresis loop–hard and soft magnetic materials- applications

Unit – III: Semiconducting Materials

Introduction to semiconducting materials – concept of doping – working principle of p-n junction diode, LED, Photo diode– solar cell – applications.

Unit – IV: Superconducting

Introduction to superconductors-Properties-Meissner effect-Type-1 &Ttype-II superconductors –BCS theory- high critical temperature (Tc)-applications.

Unit – V: Optoelectronic Materials

Introduction to Laser Principles – ruby, CO_2 lasers – applications of optoelectronic materials – introduction to optical fibers – light propagation –Fiber optic sensors- applications.

Text Books:

1. C. Kittel, Introduction to Solid State Physics, John Wiley and Sons, 7th edition,New Delhi, (2004).
2. Engineering Physics – K. Thyagarajan, McGraw Hill Publishers
3. Engineering Physics – Dr. M.N. Avadhanulu & Dr. P.G. Kshirsagar, S. Chand and Company

Reference Books:

1. V. Raghavan, Materials Science and Engineering, Prentice Hall of India, 5th edition, New Delhi, (2013).
2. B. G. Yacobi, Semiconductor Materials: An Introduction to Basic Principles, Springer, 1st edition, New York, (2013).
3. S. Kasap and P. Capper (eds.), Handbook of Electronic and Photonic Materials, Springer, New York, (2007).

<table>
<tr><td>Course Title</td><td colspan="6">Corrosion and Control</td><td colspan="3">B. Tech.
(Open elective-II)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE609</td><td rowspan="2">Open Elective</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Min</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
• To review the fundamental aspects of electrochemistry.
• It also focuses on various forms of corrosion, and their impact on life of metallurgical components, means and ways to engineer corrosion</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Recall the concepts of corrosion and its mechanism.</td></tr>
<tr><td>CO 2</td><td colspan="8">Explore different forms of corrosion and its mechanisms & prevention methods.</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze different factors which influence corrosion in different medium</td></tr>
<tr><td>CO 4</td><td colspan="8">Identify different control methods for efficient control of corrosion</td></tr>
<tr><td>CO 5</td><td colspan="8">Discuss corrosion aspects which will enable them to apply for modern engineering technology</td></tr>
</table>

Unit-1: Introduction

Introduction to corrosion, definition and types of Corrosion (Chemical- & Electrochemical Corrosion-Evolution of Hydrogen gas & Absorption of Oxygen) & its mechanisms, Pilling Bed worth Rule , Galvanic series & its applications, Factors influencing corrosion-Metal & environment..

Learning Outcomes:

At the end of the unit, The students will be able to

- Explain the types of corrosion.
- Identify the factors which influence corrosion.

Unit-2: Corrosion& Various phenomenon

Uniform Corrosion (definition, mechanism & prevention), Galvanic (Two-metal) Corrosion (Definition, mechanism & prevention), Pitting corrosion (Definition, mechanism & prevention), Concentration Cell Corrosion (Definition, mechanism & prevention),Differential aeration method (Definition, mechanism & prevention)

Learning Outcomes:

At the end of the unit, The students will be able to

- Explain the mechanisms and prevention methods of different forms of corrosion.
- Analyze the differences between pitting and galvanic corrosion.

Unit-3: Environmental Factors on Corrosion

Various factors that influence Corrosion- Corrosion in water and aqueous solution, microbiologically induced corrosion, corrosion in acidic and alkaline medium.

Learning Outcomes:
At the end of the unit, The students will be able to

- discuss various environmental factors which influence the corrosion

Unit-4: Prevention & Control
Basic principle & concepts of prevention of corrosion-Cathodic protection (Sacrificial anodic protection, Impressed current Cathodic protection), Electroplating & Electroless plating- Definition with examples (Nickel & Copper), advantages - Alternation of Environment.

Learning Outcomes:
At the end of the unit, The students will be able to

- explain the prevention methods of corrosion
- discuss the basic concepts of electroplating and electroless plating

Unit-5: Modern theory and applications of corrosion:

Introduction, Gibb's free energy, cell potentials, EMF series, Corrosion rate expressions, Importance of corrosion in engineering technology & industrial applications.

Learning Outcomes:
At the end of the unit, The students will be able to

- Analyze the rate of corrosion
- Explain the importance of Electrochemical series

Textbooks:
1. Text Book of Engineering Chemistry, Shashi Chawla, Dhanapath Rai Publications, New Delhi, 4th Edition, 2011.
2. Corrosion of metals, Helmut Kaesche, Springer Publications
3. Handbook of Corrosion Engineering, 3rd edition, Pierre R. Roberg, McGraw Hill publications
4. General Chemistry for Engineers, Jeffrey S. Gaffney & Nancy A. Marley, Elsevier publications

REFERENCES:
1. Corrosion engineering, Fontana Mars G, Mc Graw Hill publications
2. A Text Book of Engineering Chemistry, Jain and Jain, Dhanapath Rai Publishing Company, New Delhi, 15th Edition, 2010
3. Corrosion and chemical resistant masonry materials Handbook, Walter T.V. Sheppard Lee, Building materials series.
4. General chemistry by Ebbing Darrell, Himalaya Publications

Course Title	Academic Writing					OPEN ELECTIVE – II		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE615	**HUM**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 Min					**End Exam Duration: 3Hrs**			

COURSE OBJECTIVES	
1	Demonstrate and apply knowledge of basic essay structure, including introduction, body and conclusion;
2	Employ the various stages of the writing process, including pre-writing, writing and re-writing
3	Identify effective writing techniques in his or her own work and in peer writing.
4	Improve academic and idiomatic vocabulary;
5	Understand the importance of academic writing and avoid the plagiarism
COURSE OUTCOMES	
CO1	Engage with readings critically by evaluating the various contexts (social, historical, or personal) surrounding and underpinning each text
CO2	Effectively summarize and analyze various texts while identifying and highlighting their main ideas and messages
CO3	Develop independent perspectives and arguments via persuasive support and successful incorporation of research thus developing their own voice and creating a balance between their own voice and source summaries
CO4	Practice the revision skills necessary for the accomplishment of a writing project
CO5	Constructively critique their own and peers' writing, with an awareness of the collaborative and social aspects of the writing process

UNIT 1

Academic Writing

Definition- Difference between Academic and Non-academic writing – Four types of academic writing – The 4Cs of Academic Writing- Essentials of a well-structured academic writing- (Introduction, Explanation, Illustration and Conclusion)

UNIT 2

Paragraph structure

Topic sentence - supporting examples - transition sentence- Basic rhetorical modes Narration- description – exposition

UNIT 3

Writing Process and strategy

Writing Process and strategy research, planning, summarizing, organizing, plagiarism, referencing, proofreading

UNIT 4

Structure of research paper

Structure of research paper (organizing the document, transition, data implementation and display)

UNIT 5

Writing Vocabulary and language

Writing Vocabulary and language (precision, clarity, conciseness, academic vocabulary, word choice)

Text Books:

1. Hairston, et al. The Scott, Foresman Handbook for Writers (San Francisco: Longman 2002 or latest edition)

2. Stephen Bailey Academic Writing: A Handbook for International Students

Reference Books:

3. A Short Guide to College Writing, 5th edition, by Barnet, Bellanca, and Stubbs.
4. Power of Habit by Charles Duhigg. Random House Trade Paperbacks. ISBN: 978-0-8129-8160-5. Available at the IVC bookstore. You MAY use hard copy or digital version.
5. Writing Clearly: Grammar for Editing 3rd Ed. by Janet Lane & Ellen Lange. Heinle Cengage Learning, 2012 ISBN 978-1-111-35197-7. Available at the IVC bookstore.

Course Title	Basics of Financial Management for Engineers					B. Tech. Open Elective - II		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE611	Open Elective (OEC)	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	40	**60**	**100**
Mid Exam Duration: 90 Min						**End Exam Duration: 3Hrs**		

Course Objective:

- Provide an in-depth view of the process in financial management.
- Develop knowledge on the allocation, management and funding of financial

resources.

- Improving students' understanding of the time value of money concept and the role of a financial manager in the current competitive business scenario.
- Enhancing student's ability in dealing short-term dealing with day-to-day working capital decision; and also longer-term dealing, which involves major capital investment decisions and raising long-term finance.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Knowledge of the basics of Financial Management Concepts.
CO 2	To learn the concept of cost of capital and making decisions regarding raising of capital
CO 3	To understand the concept of Capital structure evaluation and related decisions.
CO 4	To build knowledge about financing and estimation of Working capital management.
CO 5	To understand the concepts of TVM, capital budgeting decisions and evaluation of Projects.
CO 6	Understanding of mergers, acquisitions and various other types financial restructurings

Unit I

Introduction to Financial Management - Concept of Business Finance, Functions of Finance, scope of Finance, Role of a Finance Manager, Goals , objectives of Financial Management, Functional areas.

Unit II

Cost of Capital - Long Term sources of finance, Concept, meaning & importance, Opportunity Cost of capital, Cost of different sources of finance, Weighted average cost of capital, factors affecting cost of capital.

Unit III

Budgeting: budgets, purpose, budgetary control, preparation of budgets, master budget, fixed and flexible

Budgeting.

Unit IV

Working Capital Management - Concept of working capital, significance, types of working capital, Factors affecting working capital needs, financing approaches for working capital, working capital estimation and calculation.

Unit V

Capital Budgeting Decision - Time Value of Money, Capital budgeting - Introduction, techniques of capital budgeting -Pay Back Method, Accounting Rate of Return, Net Present Value, Profitability Index, and Internal Rate of Return.

Text Book:

1. Financial Management by Dr. R. P. Rustagi, Taxmann's Publication.
2. Financial Management: Principles and Applications by Pearson Education; Thirteenth edition, Sheridan Titman,
3. Financial Management by I M Pandey, Pearson Education; Twelfth edition.
4. Fundamentals of Financial Management by Eugene F. Brigham, Joel F. Houston, Brigham Houston, seventh edition.
5. Financial Management Theory and Practice by Michael C. Ehrhardt and Eugene F. Brigham, Publisher, Joe Sabatino.

Reference Books:

1. Financial Management: Theory & Practice by Eugene F. Brigham and Michael C. Ehrhardt; Cengage Learning; 15 edition.
2. Fundamentals of Financial management by Dr. Eugene Brigham and Dr. Joel F.Houston: Cengage learning, Philippine Edition.
3. Financial Management Principles and practice by G. Sudarsana Reddy, Himalaya Publishing House.
4. Financial Management by Khan & Jain, Tata Mcgraw Hill.
5. Financial Management by Dr. P C Tulsian, S Chand.
6. Financial Management by Ravi Kishore, Taxmann.

<table>
<tr><td>Course Title</td><td colspan="4">Software Engineering Lab</td><td colspan="4">B.Tech. VII Sem (R20UG) AI&ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039712</td><td rowspan="2">PCC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3 Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
• To analyze and design solutions to problems using object-oriented approach.
• To make the student to learn and apply the process of object-oriented analysis and design to solve complex problems with the different applications</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Analyze problems using object-oriented approach</td></tr>
<tr><td>CO 2</td><td colspan="8">Design structural and behavioral diagrams</td></tr>
<tr><td>CO 3</td><td colspan="8">Apply forward engineering to the given problems</td></tr>
<tr><td>CO 4</td><td colspan="8">Design object-oriented models using UML.</td></tr>
<tr><td>CO 5</td><td colspan="8">Develop real time applications using object-oriented concepts</td></tr>
</table>

List of programs:

To develop a mini project the following 12 exercises listed below:

1. To develop a problem statement.
2. Develop an IEEE standard SRS document. Also develop risk management and project plan (Gantt chart).
3. Identify Use Cases and develop the Use Case model.
4. Identify the business activities and develop an UML Activity diagram.
5. Identity the conceptual classes and develop a domain model with UML Class diagram.
6. Using the identified scenarios find the interaction between objects and represent them using UML Interaction diagrams.
7. Draw the State Chart diagram.
8. Identify the User Interface, Domain objects, and technical services. Draw the partial layered, logical architecture diagram with UML package diagram notation.
9. Implement the Technical services layer.
10. Implement the Domain objects layer.
11. Implement the User Interface layer.
12. Draw Component and Deployment diagrams.

Suggested domains for Mini project:

1. Passport automation system
2. Book bank
3. Exam Registration
4. Stock maintenance system.
5. Online course reservation system
6. E-ticketing
7. Software personnel management system
8. Credit card processing
9. e-book management system
10. Recruitment system
11. Foreign trading system
12. Conference Management System
13. BPO Management System

Text Books:

1.Grady Booch, James Rumbaugh, Ivar Jacobson, The Unified Modeling Language User Guide, Pearson Education, 2nd Edition.

Reference Books:

1.Erich Gamma, Richard Belm, Ralph Johnson, John Vlissides, Design Patterns: Elements of Reusable Object Oriented Software, Addison-Wesley, 1994.

2.Meilir Page-Jones, Fundamentals of Object Oriented Design in UML, Pearson Education, 2000.

3.Atul Kahate, Object Oriented Analysis & Design, McGraw-Hill, 2004.

<table>
<tr><td>Course Title</td><td colspan="5">Deep Learning Lab</td><td colspan="3">B.Tech. VI Sem (R20UG) AI&ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039609</td><td rowspan="2">PCC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
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<tr><td colspan="5"></td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- Learn different activation functions and optimization techniques used in neural networks.
- Know the applications of deep learning models for binary and multiclass classification.
- Understand the architectures of CNN, RNN, LSTM and GRU.
- Explore various types of Categorical Data Encoding Schemes

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Illustrate Perceptron training algorithm and apply various activation functions.
CO 2	Design multi-layer neural network with Back propagation algorithm and evaluate the performance of various optimization techniques.
CO 3	Build Deep Learning models for binary and multiclass classification problems.
CO 4	Compare the application of Deep learning models CNN, RNN, LSTM and GRU
CO 5	Use data encoding schemes and develop Deep learning models for real world applications.

List of Programs:

1. Basic image processing operations: Histogram equalization, thresholding, edge detection, data augmentation, morphological operations
2. Implement Perceptron training algorithm to classify flowers in IRIS dataset.
3. Implement Activation Functions in Neural Networks and analyze their usage.
4. Build a three-layer Artificial Neural Network by implementing the Back propagation algorithm.
5. Design a GRU-based deep learning model for IMDB dataset. Compare the performance of GRU based model with LSTM based model
6. Build a Deep Neural Network for multi class text classification using Reuters dataset
7. Design a model for MNIST handwritten digit classification using Deep Convolution Neural networks.
8. Train a simple Recurrent Neural Network using an Embedding layer and a Simple RNN layer for movie review classification problem.
9. Build a Deep learning model using LSTM layer in Keras for IMDB dataset.
10. Design a Neural network with various optimization algorithms and analyze their performance using Keras.

Text Books:

1. Deep Learning with Python, Francois Chollet, Manning Publications Co.
2. Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms with contributions by Nikhil Buduma , O'Reilly publications
3. Francois Chollet, "Deep learning with Python" – Manning Publications.

Reference Books:

1. Deep Learning, Ian Good fellow, Yoshua Bengio and Aaron Courville, MIT Press, London, England.
2. Deep Learning: A Practitioner's Approach by Josh Patterson, Adam Gibs, O'Reilly publications.

<table>
<tr><td>Course Title</td><td colspan="4">Soft Skills Lab
(Skill Course – IV)</td><td colspan="3">B.Tech. VI Sem (R20UG) AI&ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2024654</td><td rowspan="2">SC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>1</td><td>0</td><td>3</td><td>2</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5"></td><td colspan="4">End Exam Duration: 3 Hrs</td></tr>
</table>

Course Objectives:

- Encourage all round development of the students by focusing on soft skills
- Outline the required skills such as interpersonal skills, communication skills.
- Aware of critical thinking and problem solving skills
- Develop leadership skills and organizing skills through group activities
- Function effectively with heterogeneous teams

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Describe the attributes of soft skills
CO 2	Understand the importance of soft skills for effective and harmonious relations
CO 3	Analyze the reasons for stress and techniques to handle for efficient performance
CO 4	Illustrate the points in multi tasks and prioritizing
CO 5	Classify communication, motivation, teamwork, time management, work ethic and flexibility

UNIT – I

Soft Skills: Introduction, meaning, Listing Soft Skills, significance of soft skills – Discussion on essential soft skills, methods to inculcate soft skills.

UNIT – II

Team Player Attitude: What is an Attitude – Attitude towards others – Importance of 'Can Do' Attitude – Openness to New Ideas – Work Behavior.

UNIT – III

Problem Solving & Decision Making: Meaning & Features of Problem Solving - Managing Conflict – Conflict Resolution – Methods of Decision Making – Effective Decision Making in Teams – Methods and Styles.

UNIT – IV

Leadership Skills: Team Building – Decision Making – Accountability – Planning – Public Speaking – Motivation – Risk Taking – Time Management.

UNIT – V

Work Ethics: Definition – Important work Ethics – Developing A Strong Work Ethic Nature in an Organization - Role and Importance of Working Ethics in a Workplace.

Suggested Software: Walden

Text Books

1. Personality Development and Softskills (English, Paperback, Mitra Barun K) Publisher: Oxford University Press; Pap/Cdr edition (July 22, 2012)
2. Soft Skills by Alex K. Published by S. Chand
3. Soft Skills: An Integrated Approach to Maximize Personality, Gajendra Singh Chauhan
4. Communication Skills and Soft Skills (Hardcover, A. Sharma) Publisher: Yking books
5. Soft Skills for a BIG IMPACT (English, Paperback, RenuShorrey) Publisher: Notion Press.

Reference Books

1. Peggy Klaus, The Hard Truth about Soft Skills
2. The Ace of Soft Skills, Gopalswamy Ramesh, Mahadevan Ramesh, Pearson Education India.
3. Eric Garner – Team Building.
4. Carnegie Dale, How to Win Friends and Influence People, New York, Fireside Publishers, 1998
5. Soft Skills, 2015, Career Development Centre, Green Pearl Publications.
6. Convey Sean, Seven Habit of Highly Effective Teens, New York, Fireside Publishers,1998.

B.Tech VII SEM AI&ML (R20)

<table>
<tr><td>Course Title</td><td colspan="4">Artificial Intelligence Analyst
(Professional Elective Course – III)</td><td colspan="4">B.Tech. VII Sem (R20UG) AI&ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039701</td><td rowspan="2">PEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3 Hrs</td></tr>
</table>

Course Objectives:

- Explain what artificial intelligence (AI) is.
- Describe the field of AI and its subfields: Machine learning, natural language processing (NLP), and computer vision.
- List applications of AI in the industry and government.
- Describe machine learning.
- Describe different type of machine learning algorithms.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Prepare students to apply AI concepts to build real-life solutions.
CO 2	Introduce students to basic concepts of AI, machine learning algorithms, natural language processing, chatbots and computervision.
CO 3	Apply the concepts they learn to practical examples by using IBM Watson services and tools on IBM Cloud.

AI Analyst
(Class Room)

Career path description: The Artificial Intelligence Analyst career path prepares students to apply AI concepts to build real-life solutions. This career path introduces students to basic concepts of AI, machine learning algorithms, natural language processing, chatbots, and computer vision. Students apply the concepts they learn to practical examples by using IBM Watson services and tools on IBM Cloud.

ibm.com/training

General Information:	
Delivery Method	25% self-placed training 75% Instructor led training
Version	2020
Products	IBM Watson Discovery, IBM Watson Assistant, IBM Watson Visual Recognition, IBM Watson Tone Analyzer, IBM Watson Natural Language Understanding, IBM Watson Studio, IBM Watson Knowledge Studio, IBM Cloud.
Audience	Undergraduate senior students from IT related academic programs such as computer science, software engineering, information systems and similar others

Learning Objectives:

After completing this course, you should be able to:

- Explain what artificial intelligence (AI) is.
- Describe the field of AI and its subfields: Machine learning, natural language processing (NLP), and computer vision.
- List applications of AI in the industry and government.
- Describe machine learning.
- Describe different type of machine learning algorithms.

- Apply machine learning algorithms to specific problems.
- Explain deep learning.
- Explain convolutional neural networks and neural networks.
- Describe examples of unsupervised and supervised learning.
- Describe IBM Watson.
- Explain how IBM Watson technology is applied to solve real world problems.
- Explain the capabilities of each IBM Watson service.
- Describe IBM Watson Studio, its components, and key applications.
- Describe the CRISP-DM process model and explain where machine learning fits in the CRISP-DM process.
- Create machine learning models for different machine learning algorithms by using IBM Watson Studio.
- Explain domain adaptation.
- Describe the purpose of training the various IBM Watson services.
- Describe IBM Watson Knowledge Studio capabilities and use.
- Explain what NLP is.
- List tools and services for NLP.
- Identify NLP use cases.
- Explain main NLP concepts.
- Explain how to evaluate the quality of an NLP algorithm.
- Identify the IBM Watson services based on NLP technology.
- Use IBM Watson Discovery to build a cognitive query application.
- Describe chatbot applications and chatbots design guidelines.
- Explain core concepts and artifacts needed to build a chatbot application.
- Build chatbot applications with IBM Watson Assistant and Node-RED.
- Explain what computer vision is.
- Identify computer vision use cases.
- Explain how computer vision analyzes and processes images and describe commonly used computer vision techniques.
- Use the IBM Watson Visual Recognition service to classify an image, detect faces, and recognize text in an image.
- Create custom models with IBM Watson Visual Recognition.
- Train the IBM Watson Visual Recognition service with IBM Watson Studio.
- Integrate multiple IBM Watson services to build a comprehensive intelligent solution.

Prerequisites Skills:

- Computer science fundamentals
- Basic knowledge of applied math, algorithms, and data modeling
- Basic knowledge of probability and statistics
- Basic knowledge of Node.js and cloud computing
- Access to IBM Cloud
- Exposure to the IBM Skills Academy Portal learning environment

Duration	36 Hours
Skill Level	Basic – Intermediate

Hardware Requirements (Classroom ILT setup Requirements)

Processor	2 GHz or Higher
GB RAM	8 GB
GB free disk Space	80 GB
Network Requirements	Yes
Other Requirements	IBM ID

Notes: The following unit and exercise durations are estimates, and might not reflect every class experience. If the course is customized or abbreviated, the duration of unchanged units will probably increase

Course Agenda			
MODULE I – AI OVERVIEW			
	Course I – AI Overview (Duration: 30 Minutes)		
	Course Overview (Duration: 05 Minutes)		
		Unit 1: Introduction to Artificial Intelligence (Duration: 03 Hours)	
		Overview	This unit explains what artificial intelligence (AI) is, its history and evolution, AI types, integral components of AI systems, factors that influenced the evolution of AI, and applications of AI in the industry, government, and science
		Learning Objectives	After completing this unit, you should be able to: • Explain what AI is. • Describe the types of AI. • List the factors that influenced the advancement of AI in recent years. • List the applications of AI in the industry, science, and government. • List the subfields that are the focus of AI research.
		Unit 2: Business Analytics (Duration: 30 Minutes)	
		Overview	This unit introduces business analytics and describes different approaches and types ofbusiness analytics
		Learning Objectives	After completing this unit, you should be able to: • Explain what business analytics is. • Describe different approaches and types of business analytics. • Describe analytical solutions. • Explain the challenges of analytical solutions.
MODULE II –			
	Course I – IBM Watson Overview (Duration: 06 Hours 30 Minutes)		
		Unit 1. Introduction to IBM Watson (Duration: 01 Hour)	
		Overview	This unit introduces IBM Watson and its history.
		Learning Objectives	After completing this unit, you should be able to: • Explain what IBM Watson is and how it works. • Explain how Watson technology is made available to developers and organizations.
		Unit 2. IBM Watson applied to industry, business and science (Duration: 01 Hours 30 Minutes)	
		Overview	This unit provides several examples that demonstrate how IBM Watson is transforming industry, business and science.
		Learning Objectives	After completing this unit, you should be able to: • Provide examples of Watson AI technologies applied to several industries.
		Unit 3. IBM Watson use cases (Duration: 30 Minutes)	
		Overview	This unit presents two use cases showing organizations that successfully implementedAI solutions, based on IBM Watson technology
		Learning Objectives	After completing this unit, you should be able to: • Describe how IBM Watson technology is being applied to solve real world problems.
		Unit 4. Evolution from Deep QA to IBM Watson services (Duration: 01 Hour)	
		Overview	This unit describes the evolution of Watson technology from the original Deep QAarchitecture to the present
		Learning Objectives	After completing this unit, you should be able to: • Explain what the Deep QA architecture was. • Explain why IBM decided to commercialize Watson.

			• Describe the evolution of Watson services from the original Deep QA architectureto the present. • Recognize the Watson services available today on the IBM Cloud.
	Unit 5. IBM Watson services overview (Duration: 02 Hours)		
		Overview	This unit provides an overview of the Watson services available in IBM Cloud.
		Learning Objectives	After completing this unit, you should be able to: • List the Watson services. • Explain the capabilities of each Watson service.
	Exercise 1. Setting up your hands-on environment (Duration: 30 Minutes)		
		Overview	This exercise guides you through the setup of your workstation before you perform the exercises in this course
		Learning Objectives	After completing this exercise, you should have: • An IBM Cloud Lite account. • C URL installed on your workstation. • Node.js installed on your workstation. • Git installed on your workstation. • A code/text editor installed on your workstation
MODULE III – AI Analyst (Duration: 26 Hours)			
	Course introduction (30 Minutes)		
	Unit 1. Introduction to machine learning (01 Hour 30 Minutes)		
		Overview	This unit recaps the main topics in Module I, AI overview and provides a deeper viewinto complex subjects such as: • Machine learning • Machine learning algorithms • Neural networks • Deep learning
		Learning Objectives	After completing this unit, you should be able to: • Explain what machine learning is. • Describe machine learning types and approaches. • List different machine learning algorithms. • Explain what neural networks and deep learning are, and why they are importantin today's AI field. • Explain how to evaluate your machine learning model.
	Exercise 1. Applying machine learning algorithms (Duration: 01 Hour 30 Minutes)		
		Overview	In this exercise, you apply machine learning algorithms to solve real problems
		Learning Objectives	After completing this exercise, you should be able to: • Determine the centroids of a data set with the K-means clustering algorithm. • Predict the class of an object with the Naïve Bayes classifier. • Apply the linear regression algorithm to solve supervised learning problems. • Construct a decision tree to predict outcomes
	Unit 2. Introduction to IBM Watson (01 Hour)		
		Overview	This unit provides an overview of key IBM Watson services, their purpose, how theywork, and helps you get started with Watson services on IBM Cloud
		Learning Objectives	After completing this unit, you should be able to: • Explain what IBM Watson is. • List IBM Watson services offerings. • List IBM Cloud Watson services. • Explain the capabilities of each Watson service.

			• List the Watson services that can be trained. • List the Watson services that cannot be trained. • Create a Watson service instance on IBM Cloud
		Exercise 2. Exploring IBM Watson services (Duration: 01 Hour 15 Minutes)	
		Overview	This exercise introduces you to Watson REST APIs. You will use URL commands to submit requests to and receive responses from several Watson services
		Learning Objectives	After completing this exercise, you should be able to: • Create Watson service instances. • Copy credentials from a service instance. • Submit API calls with the appropriate parameters. • Analyze the response returned from the Watson service. • Use Watson API Reference documentation.
		Unit 3. Introduction to IBM Watson Studio (Duration: 30 Minutes)	
		Overview	This unit provides a high level overview of Watson Studio, its components, key applications and the value added by the IBM offering
		Learning Objectives	After completing this unit, you should be able to: • Describe Watson Studio. • Identify industry use cases. • List Watson Studio offerings. • Create Watson Studio projects. • Describe Watson Studio and Spark. • Describe Watson Studio and Object Storage. • Explain Watson Studio high availability considerations. • Prepare and analyze data. • Use Jupyter notebooks.
		Exercise 3. Getting started with IBM Watson Studio (Duration: 01 Hour 30 Minutes)	
		Overview	This exercise introduces you to the basic tasks that you have to perform when usingWatson Studio
		Learning Objectives	After completing this exercise, you should be able to: • Create a Watson Studio project. • Manage the project. • Assign collaborators. • Load a data set into the project's object store. • Manage Object Storage. • Analyze data by using Watson Studio. • Use PixieDust for data visualization.
		Unit 4. Introduction to IBM Watson Machine Learning (Duration: 30 Minutes)	
		Overview	This unit describes the CRoss Industry Standard Process for Data Mining known as CRISP-DM and explains the process of preparing data for a machine learning algorithm.This unit provides an overview of the IBM Watson Machine Learning service available on IBM Cloud
		Learning Objectives	After completing this unit, you should be able to: • Describe the CRISP-DM process model. • Explain where machine learning fits in the CRISP-DM process. • Describe data preparation before feeding into machine learning algorithms. • Describe Watson Machine Learning features and capabilities
		Exercise 4. Getting started with IBM Watson Machine Learning (Duration: 01 Hour 30 Minutes)	

		Overview	This exercise introduces you to the basic tasks that you have to perform while building machine learning models for different algorithms using Watson Machine Learning andWatson Studio
		Learning Objectives	After completing this exercise, you should be able to: • Create a machine learning model by using Watson Studio and Watson MachineLearning. • Use data sets to train the model. • Use different estimators to train the machine learning model representing different machine learning algorithms. • Deploy machine learning models. • Evaluate the deployed models. • Call the deployed models from your applications. • Test the model with your data.
		Exercise 5. Exploring Deep Learning and Neural Network Modeler with IBM Watson Studio (Duration: 01 Hour)	
		Overview	This exercise guides you through designing, building, and training a deep learning model to recognize handwritten digits. The optional exercise guides you through usingthe MNIST computer vision data set to train a TensorFlow model to recognize handwritten digits.
		Learning Objectives	After completing this exercise, you should be able to: • Build a neural network to recognize handwritten digits. • Create a neural network design flow by using the neural network modeler. • Train models with experiment builder. • Work with Watson Machine Learning experiments to train deep learning models (TensorFlow).
		Unit 5. Introduction to natural language processing (NLP) (Duration: 30 Minutes)	
		Overview	This unit introduces NLP. It covers key applications of NLP, basics concepts and terminology, tools and services and NLP challenges
		Learning Objectives	After completing this unit, you should be able to: • Explain what NLP is. • Identify NLP use cases. • Explain basic NLP concepts and terminology. • List the tools and services for NLP.
		Unit 6. NLP concepts and components (Duration: 30 Minutes)	
		Overview	This unit covers NLP components, the NLP pipeline, natural language understanding, natural language generation, information retrieval, and information extraction
		Learning Objectives	After completing this unit, you should be able to: • Define the NLP categories. • Describe the NLP pipeline. • Explain the challenges in natural language understanding. • Explain the concepts of information retrieval and extraction. • Describe sentiment analysis.
		Unit 7. NLP evaluation metrics (Duration: 30 Minutes)	
		Overview	This unit explains how to evaluate the quality of your NLP algorithm.
		Learning Objectives	After completing this unit, you should be able to: • Define various metrics to measure the quality of your NLP algorithm. • Understand the difference between these metrics

		Unit 8. NLP and IBM Watson (Duration: 30 Minutes)	
		Overview	This unit lists the Watson services and software that are based on NLP and explains the main capabilities of Watson Natural Language Classifier, Watson Natural Language Understanding, Watson Discovery
		Learning Objectives	After completing this unit, you should be able to: • List the NLP Watson services • List the Watson services that perform information extraction. • Describe the capabilities of IBM Watson Natural Language Classifier. • Describe the capabilities of the IBM Watson Natural Language Understanding. • Describe the capabilities of IBM Watson Discovery
		Exercise 6. Ingest, Convert, Enrich and Query with IBM Watson Discovery Service (Duration: 01 Hour 30 Minutes)	
		Overview	This exercise takes you through the process of preparing a collection of documents and running queries to extract insights from the documents. In the optional exercise you will work with the Discovery API.
		Learning Objectives	After completing this exercise, you should be able to: • Create a Watson Discovery service instance. • Create a collection. • Add content to a collection. • Create a custom configuration. • Build queries. • Use the Discovery API.
		Unit 9. Introduction to IBM Watson Knowledge Studio (Duration: 45 Minutes)	
		Overview	This unit introduces Watson Knowledge Studio, its capabilities, and features. This unit explains the end-to-end domain adaptation process
		Learning Objectives	After completing this unit, you should be able to: • Describe IBM Watson Knowledge Studio. • List the Watson services that are trained by Knowledge Studio. • List the Knowledge Studio workspace resources. • Explain the process to build Knowledge Studio models that can be deployed and used with other Watson services.
		Exercise 7. Creating a machine learning model with Watson Knowledge Studio (Duration: 01 Hour 15 Minutes)	
		Overview	This exercise takes you through the process of building a machine learning model with Knowledge Studio that you can deploy and use with Watson services. In the optional exercise, you will create a rule-based model that you can use to find text patterns in documents
		Learning Objectives	After completing this exercise, you should be able to: • Create a workspace for Watson Knowledge Studio. • Configure the workspace resources. • Create document sets. • Pre-annotate documents. • Create tasks for human annotators. • Analyze inter-annotator agreement and adjudicate conflicts in annotated documents. • Create machine learning models.
		Unit 10. Introduction to chatbots (Duration: 30 Minutes)	

		Overview	This unit provides a high level introduction to chatbots, chatbot applications andguidelines to consider when designing a chatbot.
		Learning Objectives	After completing this unit, you should be able to: • Explain what a chatbot is. • Describe common applications of chatbots. • Identify factors that drive the growing popularity of chatbots. • Recognize the guidelines to consider when designing a chatbot. • List examples of tools and services that you can use to create chatbots.
		Unit 11. Introduction to IBM Watson Assistant (Duration: 01 Hour)	
		Overview	This unit covers the core concepts that you need to understand to build a chatbot withWatson Assistant.
		Learning Objectives	After completing this unit, you should be able to: • Explain assistants and skills. • Explain intents. • Explain entities. • Explain context variables. • Describe how the nodes in a dialog are triggered. • Describe how the dialog flow is processed. • Describe the features that can be used to enrich the chatbot.
		Exercise 8. Getting started with IBM Watson Assistant (Duration: 45 Minutes)	
		Overview	This exercise introduces IBM Watson Assistant and walks you through the process ofcreating a very simple chatbot with Watson Assistant
		Learning Objectives	After completing this exercise, you should be able to: • Create a Watson Assistant service instance. • Create a Watson Assistant skill. • Add intents. • Build a dialog.
		Exercise 9. Help Desk chatbot (Duration: 01 Hour 30 Minutes)	
		Overview	In this exercise you will create a chatbot application with Node-RED without codingand integrate it with the Watson Assistant service
		Learning Objectives	After completing this exercise, you should be able to: • Create a Watson Assistant skill. • Add intents and entities. • Build a dialog. • Create a Node-RED application that integrates with the Watson Assistant service. • Set up Slack as a front-end chat service for the Help Desk chatbot
		Unit 12. Introduction to computer vision (Duration: 30 Minutes)	
		Overview	This unit provides a high level introduction to computer vision
		Learning Objectives	After completing this unit, you should be able to: • Define computer vision. • Explain the history of computer vision and its advancement with AI. • Identify computer vision use cases. • List tools and services for computer vision
		Unit 13. Computer vision fundamentals (Duration 30 Minutes)	
		Overview	This unit explains the basic steps of a typical computer vision pipeline, how CV analyzes and processes images, and explores commonly used techniques in CV.

		Learning Objectives	After completing this unit, you should be able to: • Describe image representation for computers. • Describe the computer vision pipeline. • Describe different preprocessing techniques. • Explain image segmentation. • Explain feature extraction and selection. • Describe when object recognition takes place.
		Unit 14. Introduction to IBM Watson Visual Recognition (Duration: 45 Minutes)	
		Overview	This unit introduces the Watson Visual Recognition service, describes its capabilitiesand how to train the service
		Learning Objectives	After completing this unit, you should be able to: • Describe the IBM Watson Visual Recognition service. • List the features available with Watson Visual Recognition. • Describe the output provided by the Watson Visual Recognition service. • Explain the capabilities of the default classifier. • Explain the difference between a default and a custom classifier. • Describe how to train a custom classifier.
		Exercise 10. IBM Watson Visual Recognition model builder in IBM Watson Studio (Duration: 01 Hour)	
		Overview	In this exercise, you learn how to create, train, and test a custom model. With a custom model, you can train the Watson Visual Recognition service to classify imagesto suit your business needs
		Learning Objectives	After completing this exercise, you should be able to: • Create a Watson Visual Recognition service. • Create and train a custom Watson Visual Recognition model by using WatsonStudio. • Edit and retrain the trained model. • Describe the effect of adding a negative class when training a Watson VisualRecognition model
		Unit 15. Designing and building an intelligent solution (Duration: 45 Minutes)	
		Overview	This unit explains the benefits of integrating multiple Watson services to build a comprehensive intelligent solution. This unit presents two intelligent solutions use cases: Cognitive banking FAQ chatbot and Intelligent procurement system
		Learning Objectives	After completing this unit, you should be able to: • Explain the need to integrate multiple IBM Watson services to build an intelligentsolution. • Describe the general outline for the integration of IBM Watson Assistant withother services and applications. • Explain the key concepts that enable Watson Assistant integration. • Describe the integration flow between Watson Assistant, Watson Discovery, Watson Natural Language Understanding, and Watson Tone Analyzer to build thecognitive banking chatbot. • Describe the integration flow between Watson Knowledge Studio and WatsonDiscovery.
		Exercise 11. Creating a cognitive banking FAQ chatbot (01 Hour 30 Minutes)	
		Overview	This exercise introduces you to IBM Watson Node.js SDK to include conversation interactions, anger detection, natural language understanding, and

			answer discoveryin your FAQ chatbot application
		Learning Objectives	After completing this exercise, you should be able to: • Create a chatbot using Watson Assistant and Node.js. • Use Watson Discovery with passage retrieval to find answers in FAQ documents. • Use Watson Tone Analyzer to detect emotion in a conversation. • Identify entities in the user's input with Watson Natural Language Understanding
		Exercise 12. Integrating Watson Knowledge Studio with Discovery for the procurement domain (optional) (Duration: 01 Hour)	
		Overview	In this exercise, you will create a Discovery collection with procurement documents initially enriched by the Discovery Default Configuration. Then, you will create a Knowledge Studio machine learning model trained for the procurement domain and deploy the model to Discovery. Finally, you will evaluate the results.
		Learning Objectives	After completing this exercise, you should be able to: • Create a machine learning model in Watson Knowledge Studio and deploy it toWatson Discovery. • Create a Watson Discovery custom configuration and leverage a Watson Knowledge Studio model to enrich entities and relations. • Integrate a custom model from Watson Knowledge Studio with the Discovery service to provide custom entity and relations enrichments customized for a specific procurement domain

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<table>
<tr><td>Course Title</td><td colspan="4">Virtual And Augmented Reality
(Professional Elective Course – III)</td><td colspan="3">B.Tech. VII Sem (R20UG) AI&ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039702</td><td rowspan="2">PEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3 Hrs</td></tr>
</table>

Course Objectives:

- To Understand Virtual reality, augmented reality and using them to build bio medical engineering applications.
- To know the intricacies of these platform to develop PDA applications with better optimality.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Explore the history of spatial computing and design interactions
CO 2	Understand the foundational principles describing how hardware, computer vision algorithm's function.
CO 3	Learn Virtual reality animation and 3D Art optimization.
CO 4	Demonstrate Virtual reality.
CO 5	Introduce to the design of visualization tools

UNIT–I

Designing and Art Across Digital Realities: Introduction, Modalities, Types of common HCI modalities, New Modalities, The current state of modalities for spatial computing Devices, current controllers for immersive computing systems, Voice, Hands and Hardware inputs over the next generation.

Designing for our senses, not our devices: Envisioning a future, sensory technology, The Role of women in AI, Sensory Design, Five sensory Principles, Adobes' AR.

UNIT – II

Virtual Reality of Art: A more natural way of making 3D art, VR for animation.

3D Art Optimization: Introduction, Draw Calls, Using VR Tools for creating 3D Art, Acquiring 3D Models Versus Making them from scratch.

UNIT – III

Computer vision that makes augmented reality Possible works: History of AR, How and why to select an AR Platform, Mapping, platforms, other Development considerations, The AR Cloud.

Virtual Reality and Augmented Reality – cross- platform theory: Why cross platform, The role of game engines, understanding 3D Graphics, Portability lessons from video game design, simplifying the controller input.

UNIT – IV

Virtual Reality Toolkit: What is VRTK, History, Steam VR Unity Toolkit, VRTK v4, future of VRTK, success of VRTK

Three Virtual Reality and Augmented Reality Development Best Practices: Handling Locomotion, Locomotion in VR, Locomotion in AR, Effective use of Audio, Audio in VR, Audio in AR, Common interaction paradigms, Inventory of VR, Augmented Reality Raycasts

UNIT – V

Data and Machine learning visualization Design and Development in spatial computing: Introduction, understanding data visualization, principles for data and machine learning visualization design and development in spatial computing, why data and machine learning visualization works in spatial computing, 2D data visualization vs 3D data visualization in spatial computing, interactivity in data visualizations and in spatial computing, animation, failures in data visualization, good data visualization design optimize 3D spaces, data representations, info graphics, and interactions, defining distinctions in data visualization and big data for machine, how to create data visualization: data visualization creation pipeline, webXR, data visualization challenges in XR, data visualization industry use case examples of data visualization, 3D reconstruction and direct manipulation of real world data, data visualization is for everyone, hands on tutorials, how to create data visualization, resources.

Text Books:

1. Erin Pangilinan, Steve lukas, and Vasanth Mohan, "Creating Augmented & Virtual Realities", 1st edition, O'REILLY, 2019.

Reference Books:

1. Steve Aukstakalnis, "Practical Augmented Reality", Pearson Education, 2017.

<table>
<tr><td>Course Title</td><td colspan="4">Natural Language Processing
(Professional Elective Course – III)</td><td colspan="3">B.Tech. VII Sem (R20UG) AI&ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039703</td><td rowspan="2">PEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3 Hrs</td></tr>
</table>

Course Objectives:

- To learn the fundamentals of natural language processing.
- To understand the use of CFG and PCFG in NLP
- To understand the role of semantics of sentences and pragmatics
- To apply the NLP techniques to IR applications

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	To tag a given text with basic Language features.
CO 2	To design an innovative application using NLP components.
CO 3	To implement a rule-based system to tackle morphology/syntax of a language.
CO 4	To design a tag set to be used for statistical processing for real-time applications.
CO 5	To compare and contrast the use of different statistical approaches for different types of NLP applications.

UNIT – I

Introduction: Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM - Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance

UNIT – II

Word Level Analysis: Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

UNIT – III

Syntactic Analysis: Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs - Feature structures, Unification of feature structures.

UNIT – IV

Semantics And Pragmatics: Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

UNIT – V

Discourse Analysis And Lexical Resources: Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

Text Books:

1. Daniel Jurafsky, James H. Martin―Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2. Steven Bird, Ewan Klein and Edward Loper, ―Natural Language Processing with Python‖, First Edition, O_Reilly Media, 2009.

Reference Books:

1. Breck Baldwin, ―Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
2. Richard M Reese, ―Natural Language Processing with Java‖, O_Reilly Media, 2015.
3. Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
4. Tanveer Siddiqui, U.S. Tiwary, ―Natural Language Processing and Information Retrieval‖, Oxford University Press, 2008.

Course Title	Robotics And Automation (Professional Elective Course – IV)				B.Tech. VII Sem (R20UG) AI&ML		
Course Code	Category	Hours / Week			Credits	Maximum Marks		
2039704	PEC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 90 Minutes					End Exam Duration: 3 Hrs			

Course Objectives:

- To study the fundamental concepts of robotics and automation
- To impart knowledge on various drive system, sensors & machine vision system.
- To learn the various manipulators, grippers as well as the various dynamic process.
- To acquire the concept of kinematics and inverse kinematics.
- To understand the programming and specific industrial applications.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Summarize knowledge of basic concepts of robotic system
CO 2	Analyze the function of sensors and machine vision system in the robot.
CO 3	Categorize the drives, manipulators and grippers.
CO 4	Develop the qualitative knowledge of robot dynamics and kinematics.
CO 5	Evaluate the recent trends and application of robotics in various fields.
CO 6	Propose the theoretical concepts through specific experimental tasks

UNIT – I

Basic Concepts: Origin & various generation of Robots - Robot definition - Robotics system components - Robot classification Coordinate frames - Asimov's laws of robotics - degree of freedom - dynamic stabilization of robots. work volume. Need for Automation - types of automation - fixed, programmable and flexible automation**.**

UNIT – II

Drives, Sensors and Machine Vision: Hydraulic, Pneumatic and Electric drives - Machine vision - Sensing - Range, Proximity, Position, Velocity, Acceleration, Tactile, Acoustic, Force, Torque, Optical & laser sensors. Machine vision - Introduction, Image acquisition, Illumination Techniques, Image conversion, Cameras, Image processing and analysis – Image data reduction – Segmentation feature extraction – Object recognition.

UNIT – III

Anipulators, Grippers and Robot Dynamics: Construction of manipulators - Manipulator dynamics and force control - Electronic and Pneumatic manipulator control circuits - End effectors - Various types of grippers - Design considerations. Introduction to Robot Dynamics - Lagrange formulation - Newton Euler formulation - Properties of robot dynamic equations.

UNIT – IV

Kinematics and Path Planning: Forward Kinematics - Denavit Hartenberg Representation. Multiple solution jacobian work envelop, Inverse Kinematics - Geometric approach. Hill climbing techniques.

UNIT – V

Programming Languages and Applications: Robot programming - Fixed instruction, sequence control, General programming language, Specific programming languages. Implementation of Robots in industries-Robots for welding, painting and assembly - Remote Controlled robots - robots in manufacturing and non-manufacturing applications - Robots for nuclear and chemical plants.

Text Books:

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., "Industrial Robotics", McGraw-Hill Singapore, 1996.
2. Ghosh, "Control in Robotics and Automation: Sensor Based Integration", Allied Publishers, Chennai, 1998.
3. Asfahl C.R., "Robots and Manufacturing Automation", John Wiley, USA 1992.

Reference Books:

1. Klafter R.D., Chimielewski T.A., Negin M., "Robotic Engineering - An integrated approach", Prentice Hall of India, New Delhi, 1994.
2. M.P.Groover, "Industrial Robotics – Technology, Programming and Applications", TATA McGraw-Hill Publishing Company, New Delhi,2008.
3. Mc Kerrow P.J. "Introduction to Robotics", Addison Wesley, USA, 1991.
4. Fu K.S. Gonzaleaz R.C. and Lee C.S.G., "Robotics Control Sensing, Vision and Intelligence" McGraw Hill International Editions, 1987.
5. Janakiraman.P.A., ―Robotics and Image Processing", Tata McGraw-Hill, 1995.
6. Deb S.R," Robotics Technology and Flexible Automation", Tata McGraw Hill, New Delhi, 1994

<table>
<tr><td>Course Title</td><td colspan="4">Reinforcement Learning
(Professional Elective Course – IV)</td><td colspan="4">B.Tech. VII Sem (R20UG) AI&ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039705</td><td rowspan="2">PEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3 Hrs</td></tr>
</table>

Course Objectives:

- This course aims to provide the cutting-edge concepts in deep reinforcement learning.
- It also helps the students to train an agent which can perform a variety of complex tasks.
- It will also help students to learn about the core challenges and approaches, including generalization and exploration and also make the students well versed in the key ideas and techniques for deep reinforcement learning

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	To understand the basics of deep reinforcement learning
CO 2	To implement in code deep reinforcement learning algorithms.
CO 3	To explore the core challenges and opportunities in the field of deep reinforcement learning
CO 4	Implement and apply Monte Carlo reinforcement learning algorithms
CO 5	Implement and apply temporal-difference reinforcement learning algorithms
CO 6	Construct and apply on-policy reinforcement learning algorithms with function approximation

UNIT – I

Introduction: Introduction to Deep Reinforcement Learning – Approximate Solution Methods: On-policy Prediction with Approximation – On-policy Control with Approximation – Off-policy Methods with Approximation

UNIT – II

Recurrent And Recursive Neural Networks: Tree Recursive Neural Networks and Constituency Parsing - Recurrent neural networks for language modeling Dynamic Neural Networks for Question Answering,

UNIT – III

Convolutional Neural Networks: Convolutional Neural Networks -Recurrent and Recursive Neural Networks - Backpropagation Algorithms - Regularization and Optimization Techniques for Training such Networks.

UNIT – IV

Dynamic Programming: Dynamic Programming - Monte Carlo and Temporal Difference and Function Approximation - Reinforcement Learning Algorithms and Applications of Deep and Reinforcement Learning.

UNIT – V

Deep Reinforcement Learning: Value function methods - Deep RL with Q-learning – Multi agent RL - Eligibility Traces – Policy Gradient Methods – Applications and Case studies.

Text Books:

1. Richard.S. Sutton and Andrew G. Barto, Reinforcement Learning, second edition, MIT Press, 2018.
2. "Deep Learning" by Ian Goodfellow, YoshuaBengio, and Aaron Courville (MIT Press, 2016) http://www.deeplearningbook.org/;

Reference Books:

1. "Reinforcement Learning: An Introduction" by Richard S. Sutton and Andrew G. Barto http://incompleteideas.net/book/the-book-2nd.html

<table>
<tr><td>Course Title</td><td colspan="4">Block Chain Technologies
(Professional Elective Course – IV)</td><td colspan="3">B.Tech. VII Sem (R20UG) AI&ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039706</td><td rowspan="2">PEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3 Hrs</td></tr>
</table>

Course Objectives:

- This course helps the students to understand about distributed computing and block chain.
- It helps to know about applications of block chain.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Describe the basic concepts and technology used for blockchain.
CO 2	Describe the primitives of the distributed computing and cryptography related to blockchain.
CO 3	Illustrate the concepts of Bitcoin and their usage.
CO 4	Implement Ethereum block chain contract.
CO 5	Apply security features in blockchain technologies.
CO 6	Use smart contract in real world applications.

UNIT – I

Introduction, Need for Distributed Record Keeping, Modeling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems, Nakamoto's concept with Blockchain based cryptocurrency, Technologies Borrowed in Blockchain – hash pointers, consensus, byzantine fault-tolerant distributed computing, digital cash etc.

UNIT – II

Basic Distributed Computing & Crypto primitives, Atomic Broadcast, Consensus, Byzantine Models of fault tolerance, Hash functions, Puzzle friendly Hash, Collison resistant hash, digital signatures, public key crypto, verifiable random functions, Zero-knowledge systems

UNIT – III

Bitcoin basics, Bitcoin blockchain, Challenges and solutions, proof of work, Proof of stake, alternatives to Bitcoin consensus, Bitcoin scripting language and their use

UNIT – IV

Ethereum basics, Ethereum and Smart Contracts, The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts, Writing smart contracts using Solidity & JavaScript.

UNIT – V

Privacy, Security issues in Blockchain, Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains: Sybil attacks, selfish mining, 51% attacks advent of algorand; Sharding based consensus algorithms to prevent these attacks

Case Studies: Block chain in Financial Service, Supply Chain Management and Government Services.

Text Books:

1. Narayanan, Bonneau, Felten, Miller and Goldfeder, "Bitcoin and Cryptocurrency Technologies–A Comprehensive Introduction", Princeton University Press.
2. Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform, 2017.

Reference Books:

1. Imran Bashir, "Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained", Packt Publishing.
2. Merunas Grincalaitis, "Mastering Ethereum: Implement Advanced Blockchain Applications Using Ethereum-supported Tools, Services, and Protocols", Packt Publishing.
3. Prof. Sandip Chakraborty, Dr. Praveen Jayachandran, "Blockchain Architecture Design and Use Cases" [MOOC], NPTEL: https://nptel.ac.in/courses/106/105/106105184/

Course Title	Internet Of Things (Professional Elective Course – V)				B.Tech. VII Sem (R20UG) AI&ML		
Course Code	Category	Hours / Week			Credits	Maximum Marks		
2039707	PEC	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 90 Minutes					End Exam Duration: 3Hrs			

Course Objectives:

- Basic principles of IOT.
- Various IOT platforms and application development.
- To know about Arduino board.
- To know about Raspberry pi.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Demonstrate knowledge on Protocols, functional blocks and communication models of Internet of Things.
CO 2	Identify domain specific IoT's.
CO 3	Design appropriate solutions for IoT applications.
CO 4	Working with Arduino board.
CO 5	Design and develop applications using Raspberry pi device.

UNIT - I

Introduction to IoT: Definition and Characteristics of IoT, Physical Design of IoT, Logical Design of IoT, IoTEnabling Technologies, IoT Levels and Development Templates

UNIT - II

Domain Specific IoTs: Introduction, Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture,Industry, Health & Lifestyle.

UNIT - III

IOT and M2M: Introduction, M2M, Difference between IoT and M2M, SDN and NFV for IoT

IoT Platform Design Methodology: Introduction, IoT Design Methodology, Case Study on IoT System for Weather Monitoring.

UNIT - IV

Introduction to Arduino: Introduction, The Arduino Way, The Arduino Platform, Getting started with Arudino,Advanced Input and Output, Sample Programs.

UNIT - V

IOT Physical Devices: What is an IOT device, basic building blocks of an IOT device, Exemplary device: Raspberry Pi, about the board, linux on raspberry Pi, raspberry Pi interfaces, Programming Raspberry Pi with Python, Other IoT Devices.

Text Books:

1. Adrian McEwen,Hakin Cassimally "Designing the Internet of Things" Wiley India.
2. Getting Started with Arduino, 3rd Edition, Massimo Banzi and Michael Shiloh
3. Getting Started with Raspberry Pie, Matt Richardson & Shawn Wallace,O'Reilly-2014.
4. Arshdeep Bahga, Vijay Madisetti "Internet of Things (A hands on approach)" 1STedition, VPI publications, 2014.

Reference Books:

1. Raj Kamal, "Internet of Things", McGraw Hill, 1st Edition, 2016.
2. Internet of Things, Surya Durbha, Jyothi Joglekar, Oxford Higher Education.
3. The Internet of Things, Michael Miller, Pearson.
4. The Internet of Things, Samuel Greengard, The MIT Press Ltd.

<table>
<tr><td>Course Title</td><td colspan="5">Cognitive Science
(Professional Elective Course – V)</td><td colspan="3">B.Tech. VII Sem (R20UG) AI&ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039708</td><td rowspan="2">PEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
• Gain knowledge in basic human behavior, processing models in psychology.
• Design hypothesis using machine learning algorithms.
• Design hypothesis using machine learning algorithms.
• Understand neural network models for a human behavior.
• Apply their own model for an activity.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the basic human behaviorism of psychology</td></tr>
<tr><td>CO 2</td><td colspan="8">Understand Information processing models of psychology</td></tr>
<tr><td>CO 3</td><td colspan="8">Evaluate the hypothesis for models</td></tr>
<tr><td>CO 4</td><td colspan="8">Apply the neural network models for processing</td></tr>
<tr><td>CO 5</td><td colspan="8">Design their own model for an activity</td></tr>
</table>

UNIT – I

Introduction to Cognitive Science: The prehistory of cognitive science, The reaction against behaviorism in psychology, The theory of computation and the idea of an algorithm, Linguistics and the formal analysis of language, Information-processing models in psychology.

UNIT – II

The Integration Modelling: Language and micro-worlds, Information processing in mental imagery, An interdisciplinary model of vision, Cognitive systems as functional system, Extending computational modeling to the brain, Mapping the stages of lexical processing.

UNIT – III

Information-processing models of the mind: The physical symbol system hypothesis, From physical symbol systems to the language of thought, Expert systems, machine learning, and the heuristic search hypothesis, ID3: An algorithm for machine learning, WHISPER: Predicting stability in a block world.

UNIT – IV

Neural networks and distributed information processing: Neurally inspired models of information processing, Single-layer networks and Boolean functions, Multilayer networks, Information processing in neural networks: Key features.

UNIT – V

Neural network models of cognitive processes: Language and rules: The challenge for information-processing models, Language learning in neural networks, Object permanence and physical reasoning in infancy, Neural network models of children's physical reasoning.

Text Books:

1. Jose leuz Bermudz, Cognitive Science: An introduction to science of mind, 2nd Edition, Cambridge University press, 2014

Reference Books:

1. Jay Friedenberg, Gordon Silverman, Cognitive Science: An introduction to science of mind, Sage publications, 2006**.**

<table>
<tr><td>Course Title</td><td colspan="4">Digital Forensic
(Professional Elective Course – V)</td><td colspan="3">B.Tech. VII Sem (R20UG) AI&ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039709</td><td rowspan="2">PEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- To learn about forensic and how they are planned
- To learn about the tools used in forensic science.
- To learn about cyber crime and cyber security.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the fundamental concepts of digital forensic, digital evidence and the incident response process.
CO 2	Apply various data acquisition techniques and tools on the evidences.
CO 3	Learn the methods applicable for different forensic investigations.
CO 4	Usage of various forensic tools to analyze different forensics data
CO 5	Gains knowledge on cloud forensic procedures and challenges.
CO 6	Understand the concept of file system and their use in forensic analysis.

UNIT-I

Digital forensics: Introduction, History, Rules of Computer/ Digital forensic, Digital forensic as a discipline, Definition of digital forensic, digital forensic investigations, Goal of digital forensic investigation.

Digital evidences: Introduction, what is digital evidence, rules of digital evidence, characteristics of digital evidence, types of evidence, challenges in evidence handling, volatile evidence, evidence handling procedures.

Incidence Response: Introduction, Goals of incident response, people involved in incident response, incident respond Methodology, Activities in initial response, Phases after detection of an incident.

UNIT-II

Data Collection: Introduction, the facts in a criminal case, people involved in data collection techniques, Live data collection, Live data collection examples-Windows, Unix.

Forensic Duplication: Introduction, Rules of forensic duplication (Thumb Rule), Necessity of forensic duplication, Forensic duplicates as admissible evidence, Important terms in forensic duplicate, Forensic duplication Tool requirements, Creating a Forensic duplicate of a Hard Drive, Creating a Qualified Forensic duplicate of a hard Drive.

UNIT-III

Network Forensics: Introduction to IDS (Intrusion Detection System), Types of IDS, Advantages and disadvantages, Understanding Network intrusions and Attacks, recognizing pre-intrusion/ Attack activities, Port Scans, Address Spoofing, Attacking with Trojans, Viruses and Worms, Understanding Password cracking, Understanding Technical Exploits, Collecting Network based evidence, Investigating routers, Network Protocols.

E-Mail Forensics: Importance of E-Mail as evidence, Working of E-Mail, Steps in E- mail communication, E-mail service protocols, E-Mail forensic analysis steps, E- Mail Forensic Tools.

UNIT-IV

Mobile Forensics: Mobile hacking- SMS and Call Forging, mobile phone forensics, Forensic procedures CIA Traid, Software and hardware mobile phone tricks, Android forensics, Mobile forensic Tools.

Computer Forensic Tools: Introduction, evaluating computer forensic tool needs,types of computer forensic tools, tasks performed by computer forensic tools, Tool comparisons, software tools, hardware tools, Various computer/ Digital forensic tools.

UNIT-V

Cloud Forensics: Introduction, Three dimensions of cloud forensics, usage of cloud forensic, challenges to cloud forensic. Impact of cloud computing on digital forensic, Cloud forensic Tools.

File systems: Various types of file systems, Introduction to storage layers, Hard disk drive, Forensic Analysis of file systems.

Text Books:

1. Dr.Neelakshijain and Dr.Dhanajay R. Kalbande, Digital Forensic: The Fascinating World of Digital Evidences, Wiley Publications, 2017.

Reference Books:

1. Kevin Mandia, Chris Prosise, Incident Response and computer forensics, Tata McGraw Hill, 2006.
2. Nelson, Phillips Enfinger, Steuart, Computer Forensics and Investigations, CENGAGE Learning.
3. John R. Vacca, Computer Forensics, Computer Crime Investigation, Firewall Media, New Delhi.
4. https://www.oreilly.com/library/view/digital-forensics-with/9781597495868/

<table>
<tr><td>Course Title</td><td colspan="5">Repair & Rehabilitation of Structures</td><td colspan="3">B.Tech CE VII Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE107</td><td rowspan="2">Open Elective
(OEC III)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 1.5 Hrs</td><td colspan="3">End Exam Duration: 3 Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
To impart knowledge on the distress in structures.
To Understand the basic concepts of deterioration of structures.
To Understand the serviceability and durability aspect of structures.
Learning the materials used for retrofitting technique.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the cause of deterioration of concrete structures.</td></tr>
<tr><td>CO 2</td><td colspan="8">Able to assess the damage for different type of structures.</td></tr>
<tr><td>CO 3</td><td colspan="8">Summarize the principles of repair and rehabilitation of structures.</td></tr>
<tr><td>CO 4</td><td colspan="8">Recognize ideal material for different repair and retrofitting technique.</td></tr>
<tr><td>CO 5</td><td colspan="8">Know the artificial polymers and rust eliminators used for retrofitting works.</td></tr>
</table>

UNIT – I

Introduction

Definition for Repair, Retrofitting, Strengthening and rehabilitation.Physical and Chemical Causes of deterioration of concrete structures.

UNIT – II

Damage Assessment

Purpose of assessment, Rapid assessment, Investigation of damage, Chemical and Physical damages, Evaluation of surface and structural cracks, Damage assessment procedure, destructive, non- destructive, and semi destructive testing systems.

UNIT – III

Influence of Various Elements on Serviceability and Durability

Effects due to climate, temperature, moisture, chemicals, wear and erosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking.

UNIT – IV

Materials for Repair and Retrofitting

Artificial fiber reinforced polymer like CFRP, GFRP,AFRP and natural fiber like Sisal and Jute. Adhesive like, Epoxy Resin, Special concretes andmortars, concrete chemicals, special elements for accelerated strength gain.

UNIT – V

Maintenance and Retrofitting Techniques

Importance of Maintenance. Need for retrofitting, retrofitting of structural members i.e., column and beams by Jacketing technique, externally bonding (ERB) technique.

Text Books:

1. Sidney, M. Johnson, “Deterioration, Maintenance and Repair of Structures”
2. Denison Campbell, Allen & Harold Roper, “Concrete Structures – Materials, Maintenanceand Repair”- Longman Scientific and Technical.
3. Repair and protection of concrete structures by Noel P.Mailvaganam, CRC Press,1991
4. Concrete repair and maintenance Illustrated by Peter.H.Emmons, Galgotia publicationsPvt. Ltd., 2001.

Reference Books:

1. R. T. Allen and S.C. Edwards, “Repair of Concrete Structures”-Blakie and Sons Raiker R.N., “Learning for failure from Deficiencies in Design, Construction and Service”- R&DCenter (SDCPL).
2. M. S. Shetty, Concrete Technology – Theory and Practice, S. Chand & Co. Ltd., NewDelhi.
3. Failures and repair of concrete structures by S.Champion, John Wiley and Sons, 1961
4. Handbook on seismic retrofit of buildings, A. Chakrabarti et.al., Narosa Publishing House,2010.

<table>
<tr><td>Course Title</td><td colspan="4">Geo-Environmental Engineering</td><td colspan="3">B.Tech CE VII Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE108</td><td rowspan="2">Open Elective
(OEC III)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 1.5 Hrs</td><td colspan="3">End Exam Duration: 3 Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
To make the students to learn the concepts of geo-environmental engineering, planning and design of waste in landfills, ash ponds and tailing ponds.
To make the students to understand the effects of pollutants on soil properties
To give awareness about the adverse effects of soil and ground water contaminants
To analyze and apply various techniques for remediation of the contaminants
To make the student to understand the reuse of waste materials in geotechnical constructions.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the different types of contaminants and their effects on subsurface soils</td></tr>
<tr><td>CO 2</td><td colspan="8">Understand the waste contaminants and design the landfill</td></tr>
<tr><td>CO 3</td><td colspan="8">Understand the environmental impacts due to the contaminants of slurry waste</td></tr>
<tr><td>CO 4</td><td colspan="8">Adopt the type of barriers to protect the earth from different contaminants</td></tr>
<tr><td>CO 5</td><td colspan="8">Understand the engineering properties of the waste material and reuse in the construction</td></tr>
</table>

UNIT – I

Introduction

Industrialization and Urbanization, Pollution, Control, and remediation.

Contamination

Surface contamination, Contamination transport, Soil-a Geotechnical trap, Effect of subsurface contamination, Detection of polluted zone

UNIT – II

Contaminants of Solid Waste in Landfills

Waste contaminants, landfills, types, shape, and size of landfills. Liner and liner system, Cover and cover system, Stability of landfills.

UNIT – III

Contaminants of Slurry Wastes

Slurry transported wastes, slurry ponds, operation, Embankment construction and raising, Environmental Impact, and control.

UNIT – IV

Vertical Barriers for Contaminant

Contaminated sites, Types of barriers, Soil-Bentonite slurry trench walls, Cement-Bentonite slurry trench walls and construction material

UNIT – V

Geotechnical Reuse of Waste Materials

Waste reduction, use in geotechnical construction, waste characteristics, transportation consideration, Waste material in Embankment and Fills.

Text Books:

1. Lakshmi N. Reddi and Hilary I. Inyang, “Geoenvironmental Engineering: Principles and Applications”, CRC Press, United States.
2. Hari D. Sharma and Krishna R. Reddy, “Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies”, John Wiley and Sons, Inc., United States.
3. G.S. Birdie and J. S. Birdie, Water Supply and Sanitary Engineering, 8th Edition, Dhanpat Rai and Sons Publishers, New Delhi, 2010
4. H.S. Peavy and D.R.Rowe, Environmental Engineering, 1st Edition, McGrawHill Publishing Company, New York, 1984.

Reference Books:

1. David E. Daniel, “Geotechnical Practice for Waste Disposal”, Chapman & Hall, Springer Publishers, Germany.
2. Rowe R. Kerry, “Geotechnical and Geoenvironmental Engineering Handbook”, Springer Publishers, Germany.
3. Proceedings of the International symposium of Environmental Geotechnology (Vol. I and II), Environmental Publishing Company, 1986 and 1989.
4. ASTM Special Technical Publication 874, Hydraulic Barrier in Soil and Rock, 1985.

<table>
<tr><td>Course Title</td><td colspan="4">Environmental Impact Assessment</td><td colspan="3">B.Tech CE VII Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE109</td><td rowspan="2">Open Elective
(OEC III)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 1.5 Hrs</td><td colspan="3">End Exam Duration: 3 Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
Deals with the various impacts of infrastructure projects on the components of environment and method of assessing the impact and mitigating the same.
The student is able to know about the various impacts of development projects on environment and the mitigating measures.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Perform a critical quality review of an EIA and EIS.</td></tr>
<tr><td>CO 2</td><td colspan="8">Structure the EIA working process considering the need for interdisciplinary.</td></tr>
<tr><td>CO 3</td><td colspan="8">Perform the screening and scoping of an EIA, based on existing Requirements, evaluate the impacts and draw meaningful conclusions from the results of the EIA.</td></tr>
<tr><td>CO 4</td><td colspan="8">Clarify the concept of EIA and its application in an international context to those involved in or affected by the EIA process.</td></tr>
<tr><td>CO 5</td><td colspan="8">Interpretation an EIA, present its conclusions and translate its conclusions into actions.</td></tr>
</table>

UNIT – I

Basic Concepts of EIA

Introduction -Initial Environmental Examination – Elements of EIA – Factors Affecting E-I-A – Impact Evaluation and Analysis – Preparation of Environmental Base Map – Classification of Environmental Parameters.

UNIT – II

EIA Methodologies

Introduction – Criteria for the Selection of EIA Methodology – E I A Methods – Ad-Hoc Methods – Matrix Methods – Network Method – Environmental Media Quality Index Method – Overlay Methods and Cost/Benefit Analysis.

UNIT – III

Environmental Management Plan

EMP preparation, Monitoring Environmental Management Plan, Identification of Significant or Unacceptable Impacts Requiring Mitigation, Mitigation Plans and Relief & Rehabilitation, Stipulating the Conditions, Monitoring Methods, Pre- Appraisal and Appraisal.

UNIT – IV

Assessment of Impact on Vegetation and Wildlife

Introduction – Assessment of Impact of Development Activities on Vegetation and Wildlife.

Environmental Audit

Introduction - Environmental Audit & Environmental Legislation – Objectives of Environmental Audit – Types of Environmental Audit – Audit Protocol – Stages of Environmental Audit – Evaluation of Audit Data and Preparation of Audit Report.

UNIT – V

Environmental Acts (Protection and Prevention)

Post Audit Activities-The Air, water, Wild Life and Environmental Protection (Prevention Control Acts).

Case Studies

Preparation of EIA for developmental projects- Factors to be considered in making assessment decisions, Water Resources Project, Pharmaceutical industry, thermal plant, Highway project, Sewage treatment plant,

Text Books:

1. Y Anjaneyulu and Valli Manickam "Environmental Impact Assessment Methodologies", B S Publications, Sultan Bazar, Hyderabad.
2. J Glynn Henry and Gary W Heinke "Environmental Science and Engineering", Prentice-Hall of India (P) Limited, New Delhi.

Reference Books:

1. Dr. Suresh K Dhameja "Environmental Science and Engineering", S K Kataria & Sons Publishers, New Delhi.
2. H S Bhatia "Textbook on Environmental Pollution and Control", Galgotia Publications Pvt. Limited, New Delhi.
3. Rau and Wooten "Environmental Impact Analysis Handbook", Tata McGraw-Hill Companies, Inc. New York.

Course Title	Intelligent Control Techniques				B. Tech. EEE Open Elective - III		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE205	**Open Elective (OEC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**1**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 1Hr30M						**End Exam Duration: 3Hrs**		

Course Objectives: The objective of the course is to learn neural network and fuzzy logic concepts and foster their abilities in designing and implementing soft computing based solutions for real-world and engineering problems.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand architecture and approach to Artificial intelligence
CO 2	Understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms and their models
CO 3	Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic systems
CO 4	Understand the Bio-inspired and Swarm Intelligence Algorithms

UNIT - I

Introduction to Artificial Intelligence: Introduction and motivation – Approaches to AI – Architectures of AI – Symbolic Reasoning System –Rule based Systems – Knowledge Representation.

UNIT - II

Artificial Neural Networks: Basics of ANN - Comparison between Artificial and Biological Neural Networks – Basic Building Blocks of ANN – Artificial Neural Network Terminologies – McCulloch Pitts Neuron Model – Learning Rules.

UNIT - III

ADALINE and MADALINE Models – Perceptron Networks – Back Propagation Neural Networks – Associative Memories Neural Networks as Associative Memories

UNIT - IV

Fuzzy Logic: Classical Sets – Fuzzy Sets – Fuzzy Properties and Operations – Fuzzy Logic System – Fuzzification – Defuzzification – Membership Functions – Fuzzy Rule base – Fuzzy Logic Controller Design.

UNIT - V

Evolutionary Computation - Overview of other Bio-inspired Algorithms - Swarm Intelligence Algorithms

Text Books

1. Introduction to Neural Networks using MATLAB by S. N. Sivanandam, S. Sumathi and S. N. Deepa, Tata McGraw Hill Edition, 2006.

2. Kumar S., “Neural Networks - A Classroom Approach”, Tata McGraw Hill, 2004.
3. Fuzzy Logic with Engineering Applications by Timothy J. Ross, WILEY India Edition, 3rd Edition, 2012.

Reference Books

1. Intelligent System – Modeling, Optimization & Control by Yung C. Shin and Chengying Xu, CRC Press, 2009.
2. Eiben A. E. and Smith J. E., “Introduction to Evolutionary Computing”, Second Edition, Springer, Natural Computing Series, 2007.
3. Engelbrecht A. P., “Fundamentals of Computational Swarm Intelligence”, John Wiley & Sons, 2006.

<table>
<tr><td>Course Title</td><td colspan="4">Electrical System Estimation & Costing</td><td colspan="3">B. Tech. EEE
Open Elective - III</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE206</td><td rowspan="2">Open Elective (OEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 1Hr30M</td><td colspan="3">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn about estimating and costing of wiring systems, earthing systems, various light schemes and its calculations.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand principles of wiring systems and its estimation based on choice of wiring system</td></tr>
<tr><td>CO 2</td><td colspan="8">Understand the concepts of earthing systems</td></tr>
<tr><td>CO 3</td><td colspan="8">Understand various lightening schemes and its calculations used for domestic and industrial applications</td></tr>
<tr><td>CO 4</td><td colspan="8">Analyze estimation of wiring to residential & commercial buildings</td></tr>
</table>

UNIT-I

General principles of estimating: Estimating – purpose of estimating and costing – catalogues – market survey and source selection - determination of required quantity of materials – determination of cost material and labor.

Wiring systems: Introduction – Systems of distribution of electrical energy – methods of wiring – systems of wiring – choice of wiring systems.

UNIT – II

Earthing Systems: Earthing – Points to be earthed – Factors influencing earth resistance – methods od reducing Earth resistance – Design data on earth electrodes – Methods of earthing – determination of size of earth wire and earth plate – Effects of electric current on Human body – Measurement of earth resistance.

UNIT - III

Lighting schemes and calculations: Types of lighting circuits – Various circuit diagrams – Two way switching – Aspects of good lighting service – Types of lighting schemes – Filament Lamps- Gas filled Lamps – Fluorescent Tubes - LED lamp – Compact Fluorescent lamp (CFL) – comparison between LED and CFL – terms used in illumination – laws of illumination.

UNIT - IV

Estimation of lighting schemes: Design of lighting schemes - Factory lighting – Public lighting installations: Classification – General principles – Design – Selection of equipment - Street lighting – Methods of lighting calculations.

UNIT-V

Internal wiring estimation: General rules for wiring – determination of number of points – determination of total load – determination of sub circuits – determination of ratings of main switch and distribution board – determination of size of conductor – layout – simple problems.

Text books

1. Electrical installation estimating & Costing – J.B.Gupta, S.K.Kataria& sons.
2. Electrical design estimating and costing – K.B.Raina&S.K.Bhattacharya, NewAge International (P) Limited publishers.

Reference Books

1. Power System Analysis and Design – Dr.B.R.Gupta, S.Chand Publications
2. Electrical Estimating methods – Wayne J.Del Pico, Wiley Publishers

<table>
<tr><td>Course Title</td><td colspan="5">Entrepreneurship</td><td colspan="3">B.Tech ME VII Sem</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE311</td><td rowspan="2">OEC- III</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>--</td><td>3</td><td>30</td><td>70</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- Understand the concepts of entrepreneurship, its need and scope Understand meaning of term entrepreneur, classification of entrepreneur and qualities of an entrepreneur.
- Concept and procedure of idea generation
- Elements of business plan and its procedure
- Project management and its techniques
- 5Behavioral issues and Time management

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Identify opportunities and deciding nature of industry.
CO 2	Know the importance of Women entrepreneurship, Brainstorm ideas for new and innovative products or services.
CO 3	Identify the importance of MSME and know the preparation of Business plan.
CO 4	Use project management techniques like PERT and CPM.
CO 5	Analyze behavioral aspects and use time management matrix.

UNIT-I

Entrepreneur and Entrepreneurship: Concept of Entrepreneur, Characteristics of entrepreneur, Functions of an Entrepreneur, Types of entrepreneur, Concept of Entrepreneurship, Types of Entrepreneurship, Enterprise, Types of Enterprise, Entrepreneurial Myths, Challenges and Opportunities in Entrepreneurship in India, Role of Entrepreneurship in Economic Development,

UNIT-II

Women Entrepreneurship and Choice of Technology: Concept of Women Entrepreneur ,Problems of Women Entrepreneur ,Growth of women entrepreneurship in India, Evaluation of ideas and their sources, Selection of Technology, Collaborative interaction for Technology development, Social Responsibility and Business Ethics.

UNIT-III

MSMEs& New Venture Creation: Concept of MSME, Role & Importance of MSMEs, Growth & development of MSMEs in India, Current schemes for MSMEs, Business opportunities in India, Elements of Business Plan and its salient features presenting a business plan.

UNIT-IV

Project Management: During construction phase, project organization, project planning and control using CPM, PERT techniques, Human aspects of project management, Assessment of tax burden.

UNIT-V

Entrepreneurial Behaviours and Motivation: Introduction, Entrepreneurial Input, And Entrepreneurial Motivation: Concept and Need, Theories of Motivation, Motives for Entrepreneur

Time Management: Approaches of time management, their strengths and weaknesses. Time management matrix and the urgency addiction

Text Books:

1. Elias G. Carayannis,Elpida T. Samara "Innovation and Entrepreneurship", Springer
2.Vasant Desai, "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House, 3. S.S. Khanka, "Entrepreneurial Development", S. Chand & Co. Pvt. Ltd., New Delhi
4. Prasanna Chandra, "Project-Planning, Analysis, Selection, Implementation and Review", Tata Mcgraw-Hill Publishing Company Ltd.

Reference Books:

1. Robert D. Hisrich, Michael P. Peters, "Entrepreneurship", 5/e, Tata Me Graw Hill Publishing Company Ltd., 2015.
2. Stephen R. Covey and A. Roger Merrill, "First Things First", Simon and Schuster Publication.
3. Sudha G.S., "Organizational Behavior", National Publishing House, 1996.

Course Title	Solar Energy Systems				B.Tech ME VII Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
20OE312	OEC- III	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 90 Minutes					End Exam Duration: 3Hrs			

Course Objectives:

- Familiarize with basics of solar radiation, available solar energy and its measurement.
- Familiarize with solar collectors, construction and operation of solar collectors.
- Understand solar energy conversion systems, applications and power generation.
- Learn the principles PV technology and techniques of various solar cells/ materials for energy conversion
- Know the advance current technology of the solar energy systems for making the process economical, environmentally safe and sustainable.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Gain Knowledge On Basic Concepts Of Solar Radiation And Solar Collectors.
CO 2	Illustrate Design And Operation Of Solar Heating And Cooling Systems.
CO 3	Discuss The Principles Of Solar Thermo Photovoltaic cells
CO 4	Analyze The Performance Of A Solar Cell Array System.
CO 5	Explain Passive Heating Concepts And Passive Cooling Concepts.

UNIT – I

Solar radiation and collectors

Solar angles – Sun path diagrams – Radiation - extra terrestrial characteristics - measurement and estimation on horizontal and tilted surfaces - flat plate collector thermal analysis - testing methods-evacuated tubular collectors - concentrator collectors – classification - design and performance parameters - tracking systems - compound parabolic concentrators - parabolic trough concentrators - concentrators with point focus - Heliostats – performance of the collectors.

UNIT-II

Solar thermal technologies

Principle of working, types, design and operation of - Solar heating and cooling systems - Thermal Energy storage systems – Solar Desalination – Solar cooker : domestic, community – Solar pond – Solar drying.

UNIT – III

Solar PV fundamentals

Semiconductor – properties - energy levels - basic equations of semiconductor devices physics. Solar cells - p-n junction: homo and hetro junctions - metal-semiconductor interface - dark and illumination characteristics - figure of merits of solar cell - efficiency limits - variation of efficiency with band-gap and temperature - efficiency measurements - high efficiency cells – Solar thermo-photovoltaic cells.

UNIT - IV

SPV system design and applications

Solar cell array system analysis and performance prediction- Shadow analysis: reliability - solar cell array design concepts - PV system design - design process and optimization - detailed array design - storage autonomy - voltage regulation - maximum tracking - centralized and decentralized SPV systems - stand alone - hybrid and grid connected system - System installation - operation and maintenances - field experience - PV market analysis and economics of SPV systems.

UNIT - V

Solar passive architecture

Thermal comfort - bioclimatic classification – passive heating concepts: direct heat gain - indirect heat gain - isolated gain and sunspaces - passive cooling concepts: evaporative cooling - Radiative cooling - application of wind, water and earth for cooling; shading - paints and cavity walls for cooling - roof radiation traps - earth air-tunnel. – Energy efficient landscape design - thermal comfort.

Text Books:

1Goswami D.Y., Kreider, J. F. and Francis., “Principles of Solar Engineering’, Taylor and Francis, 2000.

2.Chetan Singh Solanki, “Solar Photovoltatics – Fundamentals, Technologies and Applications”, PHI Learning Private limited,
2011.

Reference Books:

1. Sukhatme S.P.,. Nayak.J.P, ‘Solar Energy – Principle of Thermal Storage and collection”, Tata McGraw Hill, 2008.

2. Solar Energy International, “Photovoltaic – Design and Installation Manual” – New Society Publishers, 2006.

3. Roger Messenger and Jerry Vnetre, “Photovoltaic Systems Engineering”, CRC Press, 2010.

<table>
<tr><td>Course Title</td><td colspan="4">Internal Combustion Engine</td><td colspan="3">B.Tech ME VII Sem</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE313</td><td rowspan="2">OEC- III</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- This course provides techniques of applying management principles to professional positions held by Engineers and Engineering Technologists
- The management functions, especially suited to scientist & Professionals in technical and industrial environment are part of the curriculum
- Students are exposed to the theory and practices of modern management approaches, tools and techniques in complex industrial & Competitive economic environment

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Use knowledge and comprehension in management tools to apply in technical organizations.
CO 2	Understand and build their analytical abilities in the use of Industrial Management
CO 3	Use management techniques to direct the organizations/industries for goal achievement
CO 4	Solve problems associated with the operations management and scheduling of resources in efficiently and effectively.
CO 5	The students may be asked use knowledge of management techniques and write a computer program to address and solve more complicated problems and to study the effect of various parameters on the management/organization

UNIT – I

Power Cycles:

Carnot cycle, Air standard cycles -Description and representation of Otto cycle, Diesel cycle & Dual cycles on P–V and T-S diagram -Thermal Efficiency – Comparison of Otto, Diesel and Dual cycles. Simple problems on Otto, Diesel and Dual cycles

UNIT-II

I.C. Engines:

Energy conversion – basic engine components –Classification of I.C. Engines, Working principle of two stroke and four stroke engines - comparison of two stoke and four stroke, SI and CI engines –Valve and port timing diagrams, application of I.C Engines.

UNIT – III

Engine Systems:

Working principle of, Magneto & Battery Ignition System - Simple Carburetor - Common rail fuel Injection System - Air & Thermostat cooling system - Petrol & Pressure Lubrication system.

UNIT - IV

Combustion in S.I. Engines:

Homogeneous Mixture - Stages of combustion - Importance of flame speed and factors influencing the flame speed –Abnormal Combustion - Phenomenon of Knocking, Summary of Enginevariables affecting the knocking, pre-ignition.

UNIT - V

Testing and Performance:

Engine Performance Parameters - Determination of brake power, friction power and indicated power – Performance test – Heat balance sheet and chart- Emissions from Diesel & Petrol Engines, Euro Norms - Simple problems on performance and heat balance sheet.

Text Books:

1. I.C. Engines, V. GANESAN- TMH.
2. I.C. Engines / Heywood /McGraw Hill.

Reference Books:

1. Thermal Engineering / R.K Rajput / Lakshmi Publications.
2. I.C Engines – Mathur& Sharma – DhanpathRai& Sons.
3. Engineering fundamentals of I.C Engines – Pulkrabek / Pearson /PHI
4. Thermal Engineering / Rudramoorthy – TMH

Course Title	**Electronic Instrumentation and measurements**					**Open Electives**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE405	**OE**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	-	--	3	40	60	100
Mid Exam Duration: 90 Min					**End Exam Duration: 3Hrs**			

Course Objectives:

- To study Performance characteristics of Instruments.
- To understand the principles in Analog and Digital Instruments.
- To understand the working of CROs, Transducers and bridges.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	**Understand** the performance characteristics of an instrument.
CO 2	**Understand** the principle of analog, digital voltmeters and wave analyzers
CO 3	**Explain** different types of oscilloscopes
CO 4	**Use** AC and DC bridges for relevant parameter measurement.
CO 5	**Apply** the complete knowledge of various electronic transducers to measure the physical Quantities in the field of science and technology

UNIT I

Performance characteristics of Instruments: Static characteristics, Accuracy, Resolution, Precision, Expected value, Error, Sensitivity. Errors in Measurement, Dynamic Characteristics- speed of response, Fidelity, Lag and Dynamic error.
Analog Instruments: Transistor Voltmeter, Micro Voltmeter (Chopper type) – DC Differential voltmeter – AC voltmeters – Multi meter -wave analyzers (AF & RF) – Harmonic distortion analyzer- Spectrum analyzer.

UNIT II

Digital Instruments: Digital Voltmeters (Ramp, Dual slope, stair case, successive approximation types) Digital multi meter, Universal counter, Digital tachometer, Digital Phase meter.

UNIT III

Cathode Ray Oscilloscopes: Motion of electron in electronic field and in magnetic field- Block diagram of CRO, CRT, Electrostatic deflection sensitivity – Vertical and Horizontal deflection systems – Principle of operation of dual beam, dual trace, sampling and storage CRO's- Measurements with CRO (Voltage, Current, time, frequency, Phase angle, lissajous figures).

UNIT IV

Bridges: Wheat stone bridge, Kelvin Bridge, Measurement of inductance-Maxwell's bridge, Anderson Bridge. Measurement of capacitance-Schearing Bridge, Wien Bridge Errors and precautions in using bridges- Q meter and measurement methods.

UNIT V

Transducers: Active & passive transducers**,** Resistance, Capacitance, inductance; Strain gauges, LVDT, Piezo Electric transducers, Resistance Thermometers, Thermocouples, Thermistors, Sensistors. Measurement of physical parameters force, pressure, velocity, humidity, moisture, speed, proximity and displacement. Data acquisition systems.

Text Books:

1. H.S. Kalsi," Electronic instrumentation", second edition, Tata McGraw Hill, 2004.
2. A.D. Helfrick and W.D. Cooper,"Modern Electronic Instrumentation and Measurement Techniques",PHI, 5th Edition, 2002.

References:

1. David A. Bell, "Electronic Instrumentation & Measurements", PHI (OUP), 2nd Edition, 2003.
2. Robert A.Witte, "Electronic Test Instruments, Analog and Digital Measurements", Pearson Education, 2nd Ed., 2004.
3. K. Lal Kishore, "Electronic Measurements & Instrumentations", by Pearson Education – 2005.

<table>
<tr><td>Course Title</td><td colspan="4">Introduction to IOT</td><td colspan="3">Open Electives</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE406</td><td rowspan="2">OE</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>-</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Min</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
To understand the basics of IOT.
To study the Programming Using Arduino.
To provide the knowledge about sensors and transducers.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand about IoT, its Architecture and its Applications, basic electronics used in IoT & its role.</td></tr>
<tr><td>CO 2</td><td colspan="8">Develop applications with C using Arduino IDE.</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze about sensors and actuators.</td></tr>
<tr><td>CO 4</td><td colspan="8">Design IoT in real time applications using today’s internet & wireless technologies.</td></tr>
</table>

Unit I
INTRODUCTION: Introduction to IoT: Evolution of IoT – Definition & Characteristics of IoT - Architecture of IoT – Technologies for IoT – Developing IoT Applications Applications of IoT – Industrial IoT – Security in IoT.

Unit II
BASIC ELECTRONICS FOR IoT: Basic Electronics for IoT: Electric Charge, Resistance, Current and Voltage – Binary Calculations – Logic Chips – Microcontrollers – Multipurpose Computers – Electronic Signals – A/D and D/A Conversion – Pulse Width Modulation.

Unit III
PROGRAMMING USING ARDUINO: Programming Fundamentals with C using Arduino IDE: Installing and Setting up the Arduino IDE – Basic Syntax – Data Types/ Variables/ Constant – Operators – Conditional Statements and Loops – Using Arduino C Library Functions for Serial, delay and other invoking Functions – Strings and Mathematics Library Functions.

Unit IV
SENSORS AND ACTUATORS: Analog and Digital Sensors – Interfacing temperature sensor, ultrasound sensor and infrared (IR) sensor with Arduino – Interfacing LED and Buzzer with Arduino.

Unit V
SENSOR DATA IN INTERNET: Sending Sensor Data Over Internet: Introduction to ESP8266 NODEMCU WiFi Module – Programming NODEMCU using Arduino IDE – Using WiFi and NODEMCU to transmit data from temperature sensor to Open Source IoT cloud platform (ThingSpeak).

Text Books

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things: A Hands-On Approach”, 2014. ISBN: 978-0996025515.
2. Boris Adryan, Dominik Obermaier, Paul Fremantle, “The Technical Foundations of IoT”, Artech Houser Publishers, 2017.

Reference Books

1. Michael Margolis, “Arduino Cookbook”, O‟Reilly, 2011.
2. Marco Schwartz, “Internet of Things with ESP8266”, Packt Publishing, 2016.
3. Dhivya Bala, “ESP8266: Step by Step Tutorial for ESP8266 IoT, Arduino NODEMCU Dev. Kit”, 2018.

Course Title	Nano Electronics					Open Electives		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE407	**OE**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	-	--	3	40	60	100
Mid Exam Duration: 90 Min					**End Exam Duration: 3Hrs**			

Course Objectives:
To understand the principles of tunneling, lithography and scaling of physical systems.
To provide the knowledge about MEMS and NEMS.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the divers electronic and device fabrication.
CO 2	Demonstrate the applications of FET and MOSFET
CO 3	Describe lithography.
CO 4	Analyze MEMS and NEMS

Unit-I
Tunnel junction and applications of tunneling, Tunneling Through a Potential Barrier, Metal—Insulator, Metal-Semiconductor, and Metal-Insulator-Metal Junctions, Coulomb Blockade, Tunnel Junctions, Tunnel Junction Excited by a Current Source. Spintronics and Foundations of nano-photonics.

Unit-II
Field Emission, Gate—Oxide Tunneling and Hot Electron Effects in nano MOSFETs, Theory of Scanning Tunneling Microscope, Double Barrier Tunneling and the Resonant Tunneling Diode.

Unit-III
Introduction to lithography- Contact, proximity printing and Projection Printing, Resolution Enhancement techniques, overlay-accuracies, Mask-Error enhancement factor (MEEF), Positive and negative photoresists, Electron Lithography, Projection Printing, Direct writing, Electron resists. Lithography based on Surface Instabilities: Wetting, De-wetting, Adhesion, Limitations, Resolution and Achievable / line widths etc. Lift off process, Bulk Micro machining.

Unit-IV
Introduction to MEMS and NEMS, working principles, as micro sensors (acoustic wave sensor, biomedical and biosensor, chemical sensor, optical sensor, capacitive sensor, pressure sensor and thermal sensor), micro actuation (thermal actuation, piezoelectric actuation and electrostatic actuation–micro gripers, motors, valves, pumps, accelerometers, fluidics and capillary electrophoresis, active and passive micro fluidic devices, Piezoresistivity, Piezoelectricity and thermoelectricity, MEMS/NEMS design, processing, Oxidation, Sputter deposition, Evaporation, Chemical vapor deposition etc.

Unit-V
Introduction – Scaling of physical systems – Geometric scaling & Electrical system scaling. The Single-Electron Transistor: The Single- Electron Transistor Single-Electron Transistor Logic, Other SET and FET Structures, Carbon Nanotube Transistors (FETs and SETs), Semiconductor Nanowire FETs and SETs,Coulomb Blockade in a Nanocapacitor, Molecular

SETs and Molecular Electronics.

Text Book:

1. Stephen D. Sentaria, *Microsystem Design, Kluwer Academic Press*
2. Marc Madou, *Fundamentals of microfabrication & Nanofabrication.*
3. T. Fukada & W.Mens, *Micro Mechanical system Principle & Technology, Elsevier, 1998.*
4. Julian W.Gardnes, Vijay K. Varda, *Micro sensors MEMS & Smart Devices, 2001*.

Reference Books:

1. WR Fahrner, “Nano Terchnology and Nano Electronics – Materials, devices and measurement Techniques”, Springer.
2. T.Pradeep, “Nano: The Essentials – Understanding Nano Scinece and Nanotechnology”, Tata Mc.Graw Hill.
3. M. Ziese and M.J. Thornton, “Spin Electronics”
4. Karl Goser, Peter Glosekotter, Jan Dienstuhl, “Nanoelectronics and Nanosystems – From Transistor to Molecular and Quantum Devices”.

<table>
<tr><td>Course Title</td><td colspan="5">Operating Systems
(Open Elective Course -III)</td><td colspan="3">B.Tech VII Sem (R20) CSE</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE505</td><td rowspan="2">OEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid ExamDuration:90 Minutes</td><td colspan="4">EndExamDuration:3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
• Have an overview of functions of operating systems.
• Have a thorough knowledge of process management and memory management.
• To have a thorough knowledge of how handle to deadlocks.
• Learn the concepts of files, protection and security.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the basic concepts related to the operating systems.</td></tr>
<tr><td>CO 2</td><td colspan="8">Analyze the various process scheduling algorithms and process synchronization mechanisms.</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze the various memory management schemes.</td></tr>
<tr><td>CO 4</td><td colspan="8">Understand the ways to deal the deadlocks and the basic concepts related to files in the system.</td></tr>
<tr><td>CO 5</td><td colspan="8">Analyze the protection and security mechanisms</td></tr>
</table>

UNIT - I

Operating Systems Basics: Operating systems functions, Overview of computer operating systems, distributed systems, operating system services and systems calls, system programs, operating system structure.

UNIT - II

Process Management: Process concepts, scheduling-criteria, algorithms, their evaluation.

Concurrency: Process synchronization, the critical-section problem, Peterson‘s Solution, semaphores, monitors.

UNIT-III

Memory Management: Swapping, contiguous memory allocation, paging, structure of the page table, segmentation, virtual memory, demand paging, page-replacement algorithms, Allocation of frames.

UNIT-IV

Deadlocks: system model, deadlock characterization, deadlock prevention, detection and avoidance, recovery form deadlock.

Files: The concept of a file, Access Methods, Directory structure, File system mounting.

UNIT-V

Protection: Protection, Goals of Protection, Domain of protection ,
Access Matrix, Implementation of Access Matrix.
Security: Security problems, User authentication.

Text Books:

1. Abraham Silberchatz, Peter B. Galvin, Greg Gagne, “Operating System Concepts”, Eighth edition, John Wiley.
2. Andrew S Tanenbaum, “Modern Operating Systems”, Fourth Edition, Pearson Education
3. William Stallings, “Operating Systems: Internals and Design Principles”, Sixth Edition2009, Pearson Education.
4. D.M.Dhamdhere, “Operating Systems, A Concept based Approach”, Third Edition, TMH

Reference Books:

1. A.S.Godbole, “Operating Systems”, Second Edition, TMH.
2. Operating Systems: A Spiral Approach – Elmasri, Carrick, Levine, TMH Edition.
3. Operating Systems – H.M. Deitel, P. J. Deitel, D. R. Choffnes, 3rd Edition, Pearson.
4. Operating Systems: A Practical Approach, Rajiv Chopra, 4th Edition, S Chand Publishers.

Course Title	R Programming (Open Elective Course - III)					B.Tech VII Sem (R20) CSE		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE506	**OEC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
					End Exam Duration: 3Hrs			

Course Objectives:

- Optimize business decisions and create competitive advantage with Big data analytics.
- Practice java concepts required for developing map reduce programs.
- Impart the architectural concepts of Hadoop and introducing map reduce paradigm.
- Practice programming tools PIG and HIVE in Hadoop ecosystem.
- Implement best practices for Hadoop development.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the installation of VMW is and PIG.
CO 2	Understand and apply the setting up and Installing Hadoop in its three operating modes.
CO 3	Implement the file management tasks in Hadoop.
CO 4	Understand Map Reduce Paradigm.
CO 5	Understand Pig Latin scripts sort, group, join, project, and filter your data.

UNIT-I

Introduction to R: What is R? – Why R? – Advantages of R over Other Programming Languages - R Studio: R command Prompt, R script file, comments – Handling Packages in R: Installing a R Package, Few commands to get started: installed.packages(), packageDescription(), help(), find.package(), library() - Input and Output – Entering Data from keyboard – Printing fewer digits or more digits – Special Values functions : NA, Inf and–inf.

UNIT-II

R Data Types: Vectors, Lists, Matrices, Arrays, Factors, Data Frame – **R - Variables:** Variable assignment, Data types of Variable, Finding Variable ls(), Deleting Variables - **R Operators**: Arithmetic Operators, Relational Operators, Logical Operator, Assignment Operators, Miscellaneous Operators - **R Decision Making:** if statement, if – else statement, if– else if statement, switch statement – **R Loops:** repeat loop, while loop, for loop - Loop control statement: break statement, next statement.

UNIT-III

R-Function : function definition, Built in functions: mean(), paste(), sum(), min(), max(), seq(), user-defined function, calling a function, calling a function without an argument, calling a function with argument values - **R-Strings** – Manipulating Text in Data: substr(), strsplit(), paste(), grep(), toupper(), tolower() - **R Vectors –** Sequence vector, rep function, vector access, vector names, vector math, vector recycling**,** vector element sorting **- R List -** Creating a List, List Tags and Values, Add/Delete Element to or from a List, Size of List, Merging Lists, Converting List to Vector - **R Matrices –** Accessing Elements of a Matrix, Matrix Computations: Addition, subtraction, Multiplication and Division- **R Arrays:** Naming Columns and Rows, Accessing Array Elements, Manipulating Array Elements, Calculation Across Array Elements - **R Factors** –creating factors, generating factor levels gl().

UNIT-IV

Data Frames –Create Data Frame, Data Frame Access, Understanding Data in Data Frames: dim(), nrow(), ncol(), str(), Summary(), names(), head(), tail(), edit() functions - Extract Data from Data Frame, **Expand Data Frame**: Add Column, Add Row - Joining columns and rows in a Data frame rbind() and cbind() – Merging Data frames merge() – Melting and Casting data melt(), cast().

Loading and handling Data in R: Getting and Setting the Working Directory – getwd(), setwd(), dir() - **R-CSV Files -** Input as a CSV file, Reading a CSV File, Analyzing the CSV File: summary(), min(), max(), range(), mean(), median(), apply() - Writing into a CSV File – **R -Excel File** – Reading the Excel file.

UNIT-V

Descriptive Statistics: Data Range, Frequencies, Mode, Mean and Median: Mean Applying Trim Option, Applying NA Option, Median - Mode **- Standard Deviation – Correlation - Spotting Problems in Data with Visualization:** visually Checking Distributions for a single Variable **- R –Pie Charts**: Pie Chart title and Colors – Slice Percentages and Chart Legend, 3D Pie Chart – **R Histograms** – Density Plot **- R – Bar Charts**: Bar Chart Labels, Title and Colors.

Text Books:

1. ROBERT I. KABACOFF "R in Action Data analysis and graphics with R" Manning Publications Co 2011.
2. Seema Acharya, Data Analytics using R, McGrawHill Education (India), 2018, ISBN: 978-93-5260-524-8.
3. Tutorials Point (I) simply easy learning, Online Tutorial Library (2018), *R Programming*, Retrieved from https://www.tutorialspoint.com/r/r_tutorial.pdf.
4. Andrie de Vries, Joris Meys, R for Dummies A Wiley Brand, 2nd Edition, John Wiley and Sons, Inc, 2015, ISBN: 978-1-119-05580-8.

<table>
<tr><td>Course Title</td><td colspan="4">Transforms and Their Applications</td><td colspan="3">OPEN ELECTIVE-III</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE612</td><td rowspan="2">BSC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td></td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 min</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

To enable the students to apply the knowledge of mathematics in various engineering fields by making them to learn the following:

- Laplace Transforms is used for making predictions and making analysis in data mining.
- Laplace transforms in engineering problems.
- Understand Fourier Transforms and apply them in solving problems.
- Inculcate the concept of Z-Transforms and its applications.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	**Understand** Laplace Transforms in engineering problems.
CO 2	**Apply** Laplace Transforms in engineering problems.
CO 3	**Understand** Fourier Transforms in engineering problems.
CO 4	**Apply** Fourier Transforms in engineering problems.
CO 5	**Understand** concept of Z-Transforms and its applications.

UNIT I:

Laplace transforms of standard functions – Properties of Laplace Transforms - Transforms of derivatives and integrals- Evaluation of integrals by Laplace transforms – Unit step function – Second shifting theorem – Dirac's delta function. Laplace transforms of periodic functions.

Learning Outcomes:
At the end of this unit, the student will be able to

- Understand Laplace Transforms in engineering problems.

UNIT II:

Inverse Laplace Transforms. Convolution theorem – Applications of Laplace transforms to ordinary differential equations.

Learning Outcomes:
At the end of this unit, the student will be able to

- Apply Laplace Transforms in engineering problems.

UNIT III:

Fourier integral theorem (only statement) – Fourier sine and cosine integrals. Fourier transform – Fourier sine and cosine transforms – Properties of Fourier transform.

Learning Outcomes:
At the end of this unit, the student will be able to

- Understand Fourier Transforms in engineering problems.

UNIT: IV:

Inverse transforms – Convolution theorem of Fourier transform- Parseval's identity for Fourier transforms- Relation between Fourier and Laplace transforms. Fourier transforms of the derivatives of a Function. Applications of transforms of boundary value problems (Only Heat Conduction).

Learning Outcomes:
At the end of this unit, the student will be able to

- Apply Fourier Transforms in engineering problems.

UNIT V

z-transform – Inverse z-transform – Properties – Damping rule – Shifting rule – Initial and final value theorems. Convolution theorem – Solution of difference equations by z-transforms.

Learning Outcomes:
At the end of this unit, the student will be able to

- Understand concept of Z-Transforms and its applications.

Text Books:

1. Higher Engineering Mathematics, Dr. B.S. Grewal, Khanna Publishers-43 edition 2014.
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Publications, 9th edition-2013.
3. Engineering Mathematics Volume-1, Dr. D.S Chandra Sekharaiah, Prism Books Pvt. Ltd.
4. Engineering Mathematics by Srimanta Pal, Subodh C. Bhunia, Oxford University Press.

Reference Books:

1. Higher Engineering Mathematics, B.V. Ramana, Mc. Graw Hill Education (India) Pvt. Ltd, New Delhi, 11th Edition, Reprint 2010.
2. A Text Book of Engineering Mathematics, N.P. Bali and Manish Goyal, Lakshmi Publications, Reprint 2008.
3. Advanced Engineering Mathematics, Greenberg Michael D, Cengage Publishers.
4. Introduction to Laplace Transforms and Fourier Series, Philip Dyke, Springer.

<table>
<tr><td>Course Title</td><td colspan="4">PHYSICS OF RENEWABLE ENERGY</td><td colspan="3">OPEN ELECTIVE – 3</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE613</td><td rowspan="2">BSC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End lab Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5"></td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

COURSE OBJECTIVES:
1. A top priority for developing renewable energy in India is to boost the economy, encourage the development of energy security, and reduce carbon emissions.
2. Promote sustainable development and promote economic integration.
3. Ensure that any energy sector products that come into use do so with minimal impact on the environment.
4. Take every step to ensure that energy generation, conversion, and use are cost-competitive.

COURSE OUTCOMES: Upon completion of the course, the student will be able to:

CO1	**Understand** the energy resources.
CO2	**Apply** the Solar energy.
CO3	**Idealized** wind turbine
CO4	**Underground** heat – Micro hydro plants.
CO5	**Classify** the different types of energy resources.

UNIT I: Bio diversity conception individuals

Introduction to renewable energy– Biogas cogeneration – Wood as a source of energy – Energy crops – Bio diesel – Fuel from plantation – Ethanol – Synthesis fuels.

UNIT II: Solar energy

Solar thermal: Solar collectors – Hot water from Sun – Cooling with the Sun – Solar drying – Air collectors – Solar thermal power plants.

Solar electric: Photo voltaic effect – The heart of a PV array – The solar cell – Solar energy as part of sustainable development.

UNIT III: Wind Energy

Power in the wind: Aerodynamics principles of wind turbines – Power available in the wind – Rotor efficiency – Factors affecting wind power – Impact of tower height – Wind turbines sitting – Idealized wind turbine – Power curve – Speed control for maximum power.

UNIT IV: Hydro-Energy

Introduction -Water power – Ocean wave and tidal energies – Hydro power nature conservation – Underground heat – Micro hydro plants.

UNIT V: Geothermal Energy

Introduction-Geothermal Resource -Mining Thermal Energy From a Hot Dry Rock-Geothermal Heat Pumps-Active Volcanoes, Plate Tectonics, and the “Ring of Fire”.

Text books:

1. Hand book of renewable energy technology -A.F.Zobba and R.Bansal, World scientific publications.
2. Renewable energy: The facts - Dieter Scirfried and Walter Witzel. Earth scan publications for sustainable future.

Reference books:

3. http://www.law.du.edu/index.php/the-renewable-energy-reader/6-geothermal

<table>
<tr><td>Course Title</td><td colspan="4">Fuel Technology</td><td colspan="3">B. Tech.
(Open elective-III)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE614</td><td rowspan="2">Open Elective</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Min</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
• The students will have the general knowledge of Fuels in the context of clean power, sustainability and alternative fuels
• To build up knowledge of concepts and theories of fuel combustion & control process</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Recall the Characteristics & properties of a fuel.</td></tr>
<tr><td>CO 2</td><td colspan="8">Analyze the concepts of solid fuels and evaluate the calorific value of solid fuels by Bomb Calorimeter.</td></tr>
<tr><td>CO 3</td><td colspan="8">Explore the synthesis of synthetic petrol & process of Refining of petroleum.</td></tr>
<tr><td>CO 4</td><td colspan="8">Identify various gaseous fuels and explain their preparation and properties.</td></tr>
<tr><td>CO 5</td><td colspan="8">Discuss about the purpose of different alternative fuels, merits & demerits of alternative fuels</td></tr>
</table>

UNIT-I-Introduction

Fuels-Introduction, Classification of Fuels, Differences between Solid, Liquid & gaseous fuels. Characteristics of a Good fuel, Calorific Value of Fuels-Gross calorific value(GCV) & Net calorific Value (NCV)- definition, units & their relation, Numerical problems on calorific value.

Learning Outcomes:

At the end of the unit, The students will be able to

- Classification of fuels
- Analyze the characteristics of a good fuel

UNIT-2-Solid Fuels

Introduction, Types of Coal, Coal formation, Properties, Advantage & disadvantages of solid fuels. Proximate & Ultimate analysis of coal. Manufacture of metallurgical Coke-Otto Hoffmann method, Determination of Calorific value of solid fuel by Bomb calorimeter,

Learning Outcomes:

At the end of the unit, The students will be able to

- Explain the advantages and disadvantages of solid fuel
- Determine the calorific value of fuel by Bomb Calorimeter

UNIT-3-Liquid Fuels

Introduction, Properties, Advantages & disadvantages of Liquid fuels, Classification of petroleum, refining of petroleum-Fractional distillation of crude oil, uses of various petroleum products, Synthetic Petrol- methods-Fischer-Tropsch method and Bergius process. Knocking-Octane number, Cetane Number-Definitions

Learning Outcomes:

At the end of the unit, The students will be able to

- Explain the advantages and disadvantages of Liquid fuel.
- Discuss about refining of petroleum and uses of various petroleum products.

UNIT-4-Gaseous Fuels

Introduction, Properties, Advantages & disadvantages Of Gaseous fuels - Preparation, properties & uses of Natural gas, producer gas, water gas, Propane. Determination of calorific value of gaseous fuels by Junker's Gas Calorimeter-Principle & applications.

Learning Outcomes:

At the end of the unit, The students will be able to

- Explain the advantages and disadvantages of Gaseous fuel.
- Preparation and properties of different types of gaseous fuels

Unit-5-Need for Alternate Fuels

Need for alternate fuels- Effects of Exhaust gas emissions on environment & Humans (NO, NO_2, CO_2, CO, SO_X). Introduction to alternate fuels- General uses of alternate fuels like Hydrogen, LPG, CNG, Biogas, Methanol, Ethanol, Butanol. Biofuels-Types of Biofuels, Applications of Biofuels, Merits & demerits of alternate fuels.

Learning Outcomes:

At the end of the unit, The students will be able to

- Know about the effects of exhaust gas emissions on environment and humans.
- Analyze the merits and demerits of alternate fuels

Textbooks:

1. Text Book of Engineering Chemistry, Shashi Chawla, Dhanapath Rai Publications, New Delhi, 4th Edition, 2011.
2. Internal Combustion Engine Fundamentals, Heywood John B, Pragnya IAS Publications
3. General Chemistry for Engineers, Jeffrey S. Gaffrey & Nancy A. Marky
4. Fuels & Fuel- Additives, S.P.Srivastava , Jeno Hancsok, Willey Publications

REFERENCES:

1.A Text Book of Engineering Chemistry, Jain and Jain, Dhanapath Rai Publishing Company, New Delhi, 15th Edition, 2010.

2. Alternative Liquid fuels, Desai Ashok V, Willey Publications

3. Introduction to Combustion, Turns Stephen R, Mc GrawHill Publications

4. Fuels and Fuels Technology, Wilfrid Francis, Martin C. Peters, 2nd edition, Elsevier publications

<table>
<tr><td>Course Title</td><td colspan="4">PROFESSIONAL COMMUNICATION</td><td colspan="3">OPEN ELECTIVE – III</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE615</td><td rowspan="2">HUM</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>--</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Min</td><td colspan="4">End Exam Duration: 3Hours</td></tr>
</table>

Objectives:

- To help the students get on in their professions and get success professionally.
- To help the students learn communication techniques.
- To make the students thorough with presentation skills to become effective participants in various discussions.

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	The students will be able to understand the processes of communication and apply communication techniques for effective communication.
CO 2	The students will be able to improve group behaviour and participate effectively in the team work thereby improving professional prospects.
CO 3	The students will be able to present effectively orally and in writing

Syllabus

Unit :1

1. **Professional Communication**

Role of Professional Communication- Professional Communication Skills- Tips to improve professional communication skills.

Unit 2

Technical Communication

Significance of technical communication- Use of vocabulary in formal letters / reports and e-mails.- Compound words , misspelled words, using of similar words to express the idea, analogies. Grammar: Subject - Verb agreement, Active and Passive voice, Embedded sentences, clauses and conditionals.

Unit 3

Reading Comprehension

Comprehension - Reading comprehension techniques-Styles, speed and evaluation of Reading - critical reading- Paraphrasing / summarizing: SQ3R method, PQRST method

Unit 4

Oral Presentation

Oral Presentation techniques- Public speaking - guidelines for presentation- tone and voice modulation- Use of visuals in presentation- Group Discussion - strategies

Unit 5

Writing Skills

Writing - formal and informal writing - formal and informal letters - formal and informal reports- Common errors in writing, elements of styles- Analytical and issued based essays.

Reference Books

1. Ashraf Rizvi, "Effective Technical Communication", 2nd Edition, McGraw Hill Education, 2017.

2. Raman Sharma, “Technical Communications”, Oxford Publication, London, 2004.

3. Meenakshi Raman and Sangeetha Sharma, “Technical Communication: Principles Practice”, 2nd Edition, Oxford University Press, 2011

4. English for Engineers and Technologists (Combined edition, Vol. 1 and 2), Orient Black swan 2010.

5. Stephen E. Lucas, "The Art of Public Speaking", 10th Edition; McGraw Hill Education, 2012.

6. William Strunk Jr. & E.B. White, "The Elements of Style", 4th Edition, Pearson, 1999.

7. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004.

8. Goodheart-Willcox, "Professional Communication", First Edition , 2017.

9. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India, 6 edition,2015.

10. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education; 1edition, 2013.

<table>
<tr><td>Course Title</td><td colspan="5">Digital & Social Media Management</td><td colspan="3">B. Tech.
Open Elective - III</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE616</td><td rowspan="2">Open Elective (OEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 90 Min</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is
• Review key trends within the Digital Marketing landscape. Examine an example of each Digital Marketing channel.
• Examine SEO’s Position as a Fundamental Building Block for Online Marketing
• Identify and appropriately apply Fundamental Factors That Result in Achieving Top Search Engine Rankings.
• Develop an email and sending strategy that adheres to email compliance best practices. Analyze the role that social marketing plays in the digital landscape and marketing mix.
• Identify and incorporate individual social and mobile platforms into a digital marketing strategy. Utilize Google Analytics to examine the role that web analytics play in digital marketing</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Explain the role and importance of digital marketing, Ability to comprehend how digital media can be used for current marketing practices.</td></tr>
<tr><td>CO 2</td><td colspan="8">Understanding of Search Engine optimization, Pay per click and Email marketing,</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze the role that social media marketing plays in the digital landscape and marketing mix.</td></tr>
<tr><td>CO 4</td><td colspan="8">Identify and incorporate individual social and mobile media platforms into a digital marketing strategy.</td></tr>
<tr><td>CO 5</td><td colspan="8">Understanding of content creation, content marketing channels, writing messages and content marketing plan, Utilize Google Analytics to examine the role that web analytics play in digital marketing.</td></tr>
</table>

Unit I

Introduction to Digital Marketing: Introduction to marketing in the digital environment, Online marketplace analysis: micro-environment - The Internet macro-environment, What Are the 3i Principles?

Unit II

Digital Marketing Strategy: Content Marketing - Online Offer - Online Space / website Selling - Online Value - Internet for Distribution.
Search Engine Marketing: Search Engine Optimization, Pay Per Click, Digital Display Advertising, Introduction to page rankings, Email Marketing.

Unit III

Social Media Marketing: Social Media, Social Media Mining, Content guidelines for online communications, Social Media Channels and Social Media Strategy. Cyber crime and security.

Unit IV

Mobile Marketing: Mobile Marketing Fundamentals, Mobile consumers, Digital consumption, M-commerce, Technological change and marketing, Overview of mobile and app based marketing, Mobile websites, Conducting Mobile Audits, Strategic objectives.

Unit V

Facebook for Business: Facebook for Business-Facebook fan Engagement, Anatomy of Ad Campaign, Adverts Types of adverts, Adverts Targeting. Case Study-Tata DoCoMo

Text Books

1. Digital Marketing: by Raghavendra K & ShrutiPrabhakar, HPH

References

1. e Marketing: The Essential Guide to Digital Marketing: by Rob Stokes (2010), Quirk Education.
2. The Art of Digital Marketing: by Ian Dodson, Wiley.
3. Social Media Marketing: Strategies for Engaging in Facebook, Twitter & Other Social Media: by Liana Evans, Que Publishing
4. E-Marketing: by Strauss, J. and Frost, R., Pearson Education, Inc

<table>
<tr><td>Course Title</td><td colspan="4">Industrial Safety Engineering</td><td colspan="3">B.Tech CE VII Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE110</td><td rowspan="2">Open Elective (OEC-IV)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 1.5 Hrs</td><td colspan="3">End Exam Duration: 3 Hrs</td></tr>
</table>

Course Objectives:
The course is intended to give knowledge of various safety management principles, various safety systems, various machine guarding devices, hazard identification techniques, energy sources, systems & applications and the need in the present context. Learners will be able to compare different hazard identification tools and choose the most appropriate based on the nature of industry

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Describe the theories of accident causation and preventive measures of industrial accidents
CO 2	Explain about personal protective equipment, its selection, safety performance & indicators and importance of housekeeping
CO 3	Explain different safety issues in construction industries.
CO 4	Describe various hazards associated with different machines and mechanical material handling.
CO 5	Utilise different hazard identification tools in different industries with the knowledge of different types of chemical hazards.

UNIT – I
Safety Introduction
Need for safety. Safety and productivity. Definitions: Accident, Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents. Theories of accident causation. Safety organization- objectives, types, functions, Role of management, supervisors, workmen, unions, government and voluntary agencies in safety. Safety policy. Safety Officer-responsibilities, authority. Safety committee-need, types, advantages.

UNIT – II
Personal Protection in Work Environment
Personal protection in the work environment, Types of PPEs, Personal protective equipment respiratory and non-respiratory equipment. Standards related to PPEs. Monitoring Safety Performance: Frequency rate, severity rate, incidence rate, activity rate. Housekeeping: Responsibility of management and employees. Advantages of good housekeeping. Work permit system- objectives, hot work and cold work permits. Typical industrial models and methodology. Entry into confined spaces.

UNIT – III
Safety Issues in Construction
Introduction to construction industry and safety issues in construction Safety in various construction operations – Excavation and filling – Under-water works – Under-pinning & Shoring – Ladders & Scaffolds – Tunneling – Blasting – Demolition – Confined space – Temporary Structures. Familiarization with relevant Indian Standards and the National Building Code provisions on construction safety. Relevance of ergonomics in construction safety. Ergonomics Hazards - Musculoskeletal Disorders and Cumulative Trauma Disorders.

UNIT – IV

Safety Hazards in Machines

Machinery safeguard-Point-of-Operation, Principle of machine guarding -types of guards and devices. Safety in turning, and grinding. Welding and Cutting-Safety Precautions of Gas welding and Arc Welding. Material Handling-Classification-safety consideration- manual and mechanical handling. Handling assessments and techniques- lifting, carrying, pulling, pushing, palletizing and stocking. Material Handling equipment-operation & maintenance. Maintenance of common elements-wire rope, chains slings, hooks, clamps. Hearing Conservation Program in Production industries.

UNIT – V

Hazard and Risk

Types of hazards –Classification of Fire, Types of Fire extinguishers, fire explosion and toxic gas release, Structure of hazard identification and risk assessment.

Text Books:

1. R.K Jain (2000) Industrial Safety, Health and Environment management systems, Khanna Publications.
2. Paul S V (2000), Safety management System and Documentation training Programme handbook, CBS Publication.
3. Krishnan, N.V. (1997). Safety management in Industry. Jaico Publishing House, New Delhi.
4. John V. Grimaldi and Rollin H.Simonds. (1989) Safety management. All IndiaTraveller Book Seller, Delhi.

Reference Books:

1. Ronald P. Blake. (1973). Industrial safety. Prentice Hall, NewDelhi.
2. Alan Waring. (1996). Safety management system. Chapman & Hall, England.
3. Vaid, K.N., (1988). Construction safety management. National Institute of Construction Management and Research, Mumbai.
4. AIChE/CCPS. (1992). Guidelines for Hazard Evaluation Procedures. (second edition). Centre for Chemical Process Safety, American Institute of Chemical Engineers, New York.

<table>
<tr><th>Course Title</th><th colspan="5">Surveying</th><th colspan="3">B.Tech CE VII Sem (R20)</th></tr>
<tr><th>Course Code</th><th>Category</th><th colspan="3">Hours/Week</th><th>Credits</th><th colspan="3">Maximum Marks</th></tr>
<tr><td rowspan="2">20OE111</td><td rowspan="2">Open Elective
(OEC IV)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td></td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 1.5 Hrs</td><td colspan="3">End Exam Duration: 3 Hrs</td></tr>
</table>

Course Objectives:

Be familiar with Chain and Compass in measuring the horizontal and verticaldistances, calculating simple areas, and correcting different errors.

Identify the level instruments; record the levels in field book and determine thereduced levels of objects by different methods.

Determine the areas and volumes on the field by different rules and methods.

Using totalstation instrument for measuring the distances, angles, and areas.

Understand the concepts of photogrammetry and remote sensing which can be used in higher surveying.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Compute linear and areal measurements by using chain and compass.
CO 2	Gain the knowledge on levelling and contouring techniques and its applications.
CO 3	Apply the modern surveying techniques for various field problems
CO 4	Know the uses of total station instrument for different field applications
CO 5	Know the concepts of Phostogrammetry and Remote sensing

UNIT-I

Introduction to Surveying: Definition; Classification; Principles of surveying; Errors in surveying: Types of errors; Ranging, Principles of chain surveying; Basic definitions.
Compass Surveying: Prismatic compass, Surveyor’s compass, Whole Circle and Quadrant Bearing, Included angles, and errors.

UNIT – II

Levelling: Different methods of levelling, Different types of level instruments, Levelling staff, Level field book, Reciprocal Levelling, Evaluation of Reduced Levels byRise and Fall Method, and Height of Instrument Method
Areas: Introduction; Simpson’s rule; Boundaries with offsets at irregular intervals; coordinate method; level section; two level section; trapezoidal and prismoid rule.

UNIT – III

Modern Field Survey Systems: Principle of Electronic Distance measurement; types of EDM instruments, total station, parts, accessories – advantages and applications, field procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems- Segments.

UNIT – IV

PHOTOGRAMMETRIC SURVEYING: Introduction, Basic concepts, perspective geometry of aerial photograph, relief, and tilt displacements, and terrestrial photogrammetric

UNIT – V

REMOTE SENSING: Definition, Energy Principles, radiation principles, principles, and Use of EMR spectrum, Energy interactions in atmosphere- Scattering, Absorption, Energy interactions with h surface features and concepts of spectral reflectance curve.

Text Books:

1. B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Surveying – Vol. I, II and III, Laxmi Publications (P) Ltd., 17th Edition, 2016.
2. R. Subramanian, Surveying and Levelling, Oxford University Press, 2nd Edition, 2012.
3. Chandra, A.M, Plane Surveying, 2nd Edition, New Age International Publishers, NewDelhi, 2010.
4. Surveying (Vol – 1, 2 & 3), by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain -Laxmi Publications (P) ltd., New Delhi.

Reference Books:

1. S. K. Duggal, Surveying – Vol. I and II, Tata McGraw–Hill Publishing Co. Ltd., 4th Edition,2013.
2. Arthur R. Benton and Philip J. Taetz, Elements of Plane Surveying, McGraw-Hill, 3rdEdition,2010.
3. Arora, K. R., Surveying – Vol. I and II, Standard Book House, 14th Edition, 2011.
4. T. P. Kanetkar and S. V. Kulkarrni, Surveying and Levelling, Pune Vidyarthi GrihaPrakashan, Pune, 24th Edition, 2013.

<table>
<tr><td>Course Title</td><td colspan="5">Traffic Engineering</td><td colspan="3">B.Tech CE VII Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE112</td><td rowspan="2">Open Elective
(OEC IV)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 1.5 Hrs</td><td colspan="3">End Exam Duration: 3 Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
The objective of this course is to impart knowledge about various components and characteristics of traffic to understand concepts like Highway capacity and level of service concepts. To know various traffic control devices and principles of highway safety.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Conduct different engineering surveys required for highway planning and design</td></tr>
<tr><td>CO 2</td><td colspan="8">Analyze the traffic flow patterns and delay patterns</td></tr>
<tr><td>CO 3</td><td colspan="8">Understand the role and importance of various traffic control devices</td></tr>
<tr><td>CO 4</td><td colspan="8">Know the impact of traffic on environmental pollution and standard pollution limits</td></tr>
<tr><td>CO 5</td><td colspan="8">Understand the concepts of level of service of highways along with various highway systems required for traffic surveillance</td></tr>
</table>

UNIT – I

Components of the Traffic System

Human-Vehicle–Environment System; characteristics of Road users, Vehicles, Highways and their classification; Traffic Studies: Inventories; Volume studies; Speed, Accident studies.

UNIT – II

Traffic Characteristics

Microscopic and macroscopic flow characteristics: Time headways; Temporal, spatial and model flow patterns; Interrupted and Un interrupted traffic. Travel time and delay studies, Car-following theories.

UNIT – III

Traffic Control Devices & Highway Safety

Traffic signs & Markings; Signal Warrants; Signal phasing and Development of phase plans; Fixed and Vehicle activated signals; Accident characteristics – Road – Driver – Vehicle; Accident recording and Analysis; Highway Safety Improvement Program; Safety Audit.

UNIT – IV

Environmental Considerations

Air pollution: Kinds of pollutants; Air pollution standards; Measures of air quality; modelling and control. Noise pollution: Measurement of sound levels; Acceptable limits, Prediction of noise levels, Traffic noise control.

UNIT – V

Highway Capacity and Level of Service

Capacity and level of service; Factors affecting Capacity and LOS; Capacity of Rural

Highways, Capacity of Urban Roads;
Highway Systems: Traffic surveillance and monitoring; Intelligent vehicle highway system. IVHS programs, Role of IVHS, IVHS categories, Benefits and Costs of IVHS.

Text Books:

1. L R Kadiyali "Principles and Practice of Highway Engineering", Khanna Publishers, NewDelhi.
2. S K Khanna, C E G Justo and A Veeraragavan "Highway Engineering", Nemchand Publications, New Delhi.
3. Papacoastas, C. S. and Prevedouros, Transportation Engineering and Planning, ThirdEdition, Third Impression; Pearson Education, 2018.
4. Highway Engineering, Paul H. Wright and Karen K Dixon, Wiley Student Edition, WileyIndia (P) Ltd., New Delhi

Reference Books:

1. G V Rao "Principles of Transportation and Highway Engineering", Tata McGraw-HillCompanies, Inc. NewYork.
2. Partha Chakroborthy, Animesh Das, "Principles of Transportation Engineering", PrenticeHall of India, New Delhi.
3. S P Bindra "Highway Engineering", Dhanpath Rai & Sons, New Delhi.
4. Traffic & Highway Engineering by Nicholas J. Garber, Lester A. Hoel, Fifth Edition, published in 2015, CENGAGE Learning, New Delhi.

<table>
<tr><td>Course Title</td><td colspan="4">Basics of Power Electronics</td><td colspan="4">B. Tech. EEE
Open Elective - IV</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE207</td><td rowspan="2">Open Elective (OEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 1Hr30M</td><td colspan="3">End Exam Duration 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn basic fundamentals of power electronics devices and to classify the different kinds of power electronics circuits as a function of the input source and loads.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">To understand the characteristics of different power switches.</td></tr>
<tr><td>CO 2</td><td colspan="8">To understand the single phase and three phase controlled rectifier with different loads</td></tr>
<tr><td>CO 3</td><td colspan="8">To understand the operating principle of cyclo converters, choppers and inverters</td></tr>
<tr><td>CO 4</td><td colspan="8">To understand harmonic content in output voltage and current waveforms of an inverter.</td></tr>
</table>

UNIT - I

Fundamentals of Power Semi-conductor devices: SCR – static characteristics –turn on and off mechanism – MOSFET, IGBT, GTO Characteristics.

UNIT - II

Phase controlled Rectifiers(AC to DC): Phase controlled rectifiers – single phase half and fully controlled converters – midpoint and bridge connections with R and RL loads – effect of source inductance- three phase half controlled converters with R load .

UNIT - III

AC Voltage Controllers (AC to AC): AC voltage controllers- single phase ac voltage controllers with SCR for R and RL load – cyclo converters – single phase cyclo converters (mid-point configuration) with R load.

UNIT - IV

Choppers (DC to DC): Choppers – principle of operation – control strategies- types of chopper circuits – type A, type B- buck -boost converter.

UNIT - V

Inverters (DC to AC): Inverters – single phase half bridge and full bridge inverters with R and RL load –output voltage control techniques - PWM techniques- harmonic reduction techniques.

Text Books

1. Power Electronics –M.D Singh & K.B. Kanchandhani, TMH publications, 1998.

2. Power Electronics - Circuits, Devices and Applications –M.H. Rashid, Prentice Hall of India, 2nd Edition 1998.

Reference Books

1. Power Electronics- P.S. Bimbhra, Khanna Publications.
2. Power Electronics –Vedam Subramanyam, New Age Information Limited, 3rd Edition.
3. Power Electronics –V.R. Murthy, Oxford University Press, 1st Edition – 2005.
4. Power Electronics –P.C Sen, Tata Mc Graw Hill Publishing.

<table>
<tr><td>Course Title</td><td colspan="4">System Reliability Concepts</td><td colspan="3">B. Tech. EEE
Open Elective - IV</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE208</td><td rowspan="2">Open Elective (OEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 1Hr30M</td><td colspan="3">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn basic probability theory, network modeling, time dependent probability, markov modeling and system reliability evaluation.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the concept of basic probability theory, binomial distribution, network reliability, reliability functions, time dependent probability, markov chains & process and system reliability</td></tr>
<tr><td>CO 2</td><td colspan="8">Apply probability rules to find probability distributions, network reliability for series, parallel, series-parallel, complex networks</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze the failure rate distributions, bath-tub curve, STPM, continuous markov process and frequency duration techniques for single and two repairable components</td></tr>
<tr><td>CO 4</td><td colspan="8">Evaluate transitional rates, cumulative probability and frequency n-component repairable models</td></tr>
</table>

UNIT-I

Basic Probability Theory: Basic concepts – Rules for combining Probabilities of events – Failure Density and Distribution functions – Bernoulli's trials – Binomial distribution – Expected value and standard deviation for binomial distribution – Examples.

UNIT-II

Network Modeling and Reliability Evaluation: Basic concepts – Evaluation of network Reliability / Unreliability – Series systems, Parallel systems, Series - Parallel systems, partially redundant systems – Types of redundancies - Evaluation of network Reliability / Unreliability using conditional probability method – Paths based and Cut set based approach – Examples.

UNIT-III

Time Dependent Probability: Basic concepts – Reliability functions f(t), F(t), R(t), h(t) – Relationship between these functions – Bath tub curve – Expected value and standard deviation of Exponential distribution – Measures of reliability – MTTF, MTTR, MTBF – Evaluation of network reliability / Unreliability of simple Series, Parallel – Examples.

UNIT-IV

Discrete Markov Chains: Basic concepts – Stochastic transitional Probability matrix (STPM) – Limiting State Probability evaluation – Absorbing states.

Continuous Markov Processes: Modeling concepts – State space diagrams – time dependent reliability evaluation of single component repairable model – Evaluation of Limiting State Probabilities of one, two component repairable models – Frequency and duration concepts – Frequency balance approach.

UNIT-V

Multi Component & Approximate System Reliability Evaluation: Recursive relation for evaluation of equivalent transitional rates, cumulative probability and cumulative frequency and 'n' component repairable model - Series systems, Parallel systems, Basic reliability indices – Cut-set approach – Examples.

Text Books

1. Reliability Evaluation of Engineering Systems by Roy Billinton and Ronald N. Allan, Reprinted in India B. S. Publications, 2007.
2. System Reliability Concepts by V. Sankar, Himalaya Publishing House, 2015.

Reference Books

1. Reliability Engineering by E. Balagurusamy, Tata McGraw Hill, 2003.
2. Reliability and Maintainability Engineering by Charles E. Ebeling, Tata McGraw Hill, 2000.

<table>
<tr><td>Course Title</td><td colspan="4">Energy Auditing</td><td colspan="3">B.Tech ME VII Sem</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE314</td><td rowspan="2">OEC- IV</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- Introduce the concepts of energy scenario and need for energy policy for industries in India.
- Familiarize with the Energy Audit concepts and its approaches.
- Teach the principles and objectives of the Energy management.
- Discuss the Thermal and Electrical Energy management.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Explain the fundamental aspects of energy scenario in India.
CO 2	List the various national and state level energy policy.
CO 3	Explain the concepts of energy conservation in boilers.
CO 4	Identify the thermal energy components.
CO 5	Explain the concepts of supply side methods to minimize supply.

UNIT – I

General Aspects

Review of energy scenario in India, General Philosophy and need of Energy Audit and Management, Basic elements and measurements - Mass and energy balances – Scope of energy auditing industries - Evaluation of energy conserving opportUNITies, Energy performance contracts, Fuel and Energy substitution, Need for Energy Policy for Industries, National & State level energy Policies.

UNIT-II

Energy Audit Concepts

Need of Energy audit - Types of energy audit – Energy management (audit) approach - understanding energy costs - Bench marking – Energy performance - Matching energy use to requirement - Maximizing system efficiencies -Optimizing the input energy requirements - Duties and responsibilities of energy auditors- Energy audit instruments - Procedures and Techniques.

UNIT – III

Principles and Objectives of Energy Management

Design of Energy Management Programmes - Development of energy management systems – Importance - Indian need of Energy Management - Duties of Energy Manager - Preparation and presentation of energy audit reports - Monitoring and targeting, some case study and potential energy savings.

UNIT - IV

Thermal Energy Management

Energy conservation in boilers - steam turbines and industrial heating systems - Application of FBC - Cogeneration and waste heat recovery -Thermal insulation - Heat exchangers and heat pumps –HVC industries-Building Energy Management.

UNIT - V

Electrical Energy Management

Supply side Methods to minimize supply-demand gap- Renovation and modernization of power plants - Reactive power management – HVDC- FACTS - Demand side - Conservation in motors - Pumps and fan systems – Energy efficient motors.

Text Books:

1. Murphy, W. R., Energy Management, Elsevier, 2007.
2. Smith, C. B., Energy Management Principles, Pergamum, 2007
3. Handbook of Energy Audit, Sonal Desai, Mcgraw Hill Education Private Ltd

Reference Books:

1.Turner, W. C., Doty, S. and Truner, W. C., Energy Management Hand book, 7th edition, Fairmont Press, 2009.
2. De, B. K., Energy Management audit & Conservation, 2nd Edition, Vrinda Publication, 2010.
3. Energy Management Handbook – W.C. Turner (John Wiley and Sons, A Wiley a. Interscience publication)
4. Industrial Energy Management and Utilisation –L.C. Witte, P.S. Schmidt, D.R. Brown (Hemisphere Publication, Washington, 1988)
5. Industrial Energy Conservation Manuals, MIT Press, Mass, 1982
6. Energy Conservation guide book Patrick/Patrick/Fardo (Prentice hall1993)

<table>
<tr><td>Course Title</td><td colspan="4">Sustainable Engineering</td><td colspan="3">B.Tech ME VII Sem</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE315</td><td rowspan="2">OEC- IV</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- To have an increased awareness among students on Issues in areas of sustainability.
- To understand the role of Engineering and technology within sustainable development
- To know the Methods ,tools and incentives for sustainable product service system development
- To Establish a clear understanding of the role and impact of various aspects of Engineering and emerging decisions on environmental, societal and economic problems

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the relevance and the concept of sustainability and the global initiatives in this Direction.
CO 2	Explain the different types of environmental pollution problems and their sustainable
CO 3	Discuss the environmental regulations and standards .
CO 4	Outline the concepts related to conventional and non-conventional energy
CO 5	Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles.

UNIT-I

Sustainability:

Introduction, concept, evolution of the concept; Social, environmental and economic sustainability concepts; Sustainable development, Nexus between Technology and Sustainable development; Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), Clean Development Mechanism (CDM).

UNIT – II

Environmental Pollution:

Air Pollution and its effects, Water pollution and its sources, Zero waste concept and 3 R concepts in solid waste management; Greenhouse effect, Global warming,
Climate change, Ozone layer depletion, Carbon credits, carbon trading and carbon foot print, legal provisions for environmental protection.

UNIT – III

Environmental management standards: ISO 14001:2015 frame work and benefits, Scope and goal of Life Cycle Analysis (LCA), Circular economy, Bio-mimicking, Environment Impact Assessment (EIA), Industrial ecology and industrial symbiosis.

UNIT – IV

Resources and its utilization: Basic concepts of Conventional and non-conventional energy, General idea about solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans and Geothermal energy.

UNIT-V

Sustainability practices: Basic concept of sustainable habitat, Methods for increasing energy
efficiency in buildings, Green Engineering, Sustainable Urbanization, Sustainable cities, Sustainable transport

Text Books:

1.Sustainable Engineering: Drivers, Metrics, Tools, And Applications
Krishna R. Reddy, Claudio Cameselle, Jeffrey A. Adams.

2. Introduction to Sustainability for Engineers ByTulseeram, Ramjeawon

3. sustainable Engineering: Principles and Practice Hardcover – 13 June 2019 by Bhavik R. Bakshi

Reference Books:

1. Allen, D. T. and Shonnard, D. R., Sustainabilitngineering: Concepts, Design and Case Studies,PrenticeHall.

2. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development,Cengageleaming

3. Environment Impact Assessment Guidelines, Notification of Government of India, 2006

4.Mackenthun, K. M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998

5. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System

<table>
<tr><td>Course Title</td><td colspan="4">Industrial Engineering & Management</td><td colspan="3">B.Tech ME VII Sem</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE316</td><td rowspan="2">OEC- IV</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- This course provides techniques of applying management principles to professional positions held by Engineers and Engineering Technologists
- The management functions, especially suited to scientist & Professionals in technical and industrial environment are part of the curriculum
- Students are exposed to the theory and practices of modern management approaches, tools and techniques in complex industrial & Competitive economic environment

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the concepts of Management, organization principles and also motivational qualities and leadership.
CO 2	Apply the knowledge where to and how to locate a plant, difficulties of plant layout.
CO 3	Evaluate various types of work studies processing charts and job evaluation techniques.
CO 4	Apply types of control charts and improvement of quality with analysis techniques.
CO 5	Use knowledge of management techniques in improving the Entreprise planning and project management.

UNIT-I

INTRODUCTION:

Concepts of Management and Organization – Functions of Management – Evolution of Management Thought : Taylor‟s Scientific Management, Fayol‟s Principles of Management, Douglas McGregor‟s Theory X and Theory Y, Mayo‟s Hawthorne Experiments, Hertzberg‟s Two Factor Theory of
Motivation, Maslow‟s Hierarchy of Human Needs, Systems Approach to Management.

UNIT-II

PLANT LOCATION & LAYOUT:

Plant location, definition, factors affecting the plant location, comparison of rural and urban sites- methods for selection of plant.Types of production systems, Plant Layout – definition, objectives and types of plant layout.

UNIT-III

WORK STUDY:

Introduction, objectives of work study, steps in work study, purpose of method study, procedure of method study, recording techniques. Work measurement-purpose of work measurement, time studyprocedure-performance rating, standard time calculations (simple problems).

UNIT-IV

MATERIALS MANAGEMENT:

Objectives, Inventory – functions, types, associated costs, inventory controltechniques-ABC and VED analysis. Stores Management and Stores Records. Purchasemanagement duties ofpurchase of manager, associated forms, purchase procedure, methods of purchasing. Introduction to production planning and control (PPC) Objectives of PPC, Functions of PPC

UNIT-V

QUALITY CONTROL:

Meaning, process control, SQC control charts, single, double and sequential sampling, Introduction to TQM. Job Evaluation and merit rating: introduction-Job evaluation-objectives, benefits and limitations of job evaluation-methods of job evaluation.

Text Books:

1. DR. Ravi Shankar: Industrial Engineering and management/Galgotia publications pvt. Ltd.
2. Khanna O.P.: Industrial Engineering

Reference Books:

1. Industrial engineering and operations management by S.K. Sharma and Savita Sharma.
2. T.R. Banga : Industrial Engineering and Management
3. M. Mahajan: Industrial engineering and production management, DhanpatRai& Co.

<table>
<tr><td>Course Title</td><td colspan="4">Fundamentals of RADAR Engineering</td><td colspan="3">Open Electives</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE408</td><td rowspan="2">OE</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>-</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Min</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
• To gain the knowledge about radar subsystems, their performance and key functions.
• To provide the in depth knowledge and issues related various tracking radars.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the essential principles of operation of radar systems.</td></tr>
<tr><td>CO 2</td><td colspan="8">Describe the various Radar components</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze different Radar systems</td></tr>
<tr><td>CO 4</td><td colspan="8">Analyze the different Tracking methods</td></tr>
</table>

UNIT-I

Fundamentals: Nature of Radar, Maximum Unambiguous Range, Radar Waveforms, Radar block diagram and operation, Radar frequencies, Applications of Radar, simple form of radar range equation. Integration of Radar pulses, Radar cross-Section of targets, PRF.

UNIT-II

Radar components: RF amplifier, TWT, CFA, Modulators, Mixers-Conversion loss, Noise figure, Types of Mixers, Duplexers-Branch type, Balanced and Solid state Duplexers, Displays-CRT displays, A, B, C, E-scopes, PPI, RHI.

UNIT-III

Radar systems: Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar, FMCW radar, multiple frequency C.W radar.

UNIT-IV

MTI and Pulse Doppler radar: Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs. Range Gated Doppler Filters. MTI Radar Parameters, Limitations to MTI Performance. Non-coherent MTI, MTI versus Pulse Doppler radar.

UNIT-V

Tracking Radar: Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar – Amplitude Comparison Monopulse (one- and two- coordinates), Phase Comparison Monopulse. Target Reflection Characteristics and Angular Accuracy. Tracking in

Range, Acquisition and Scanning Patterns. Comparison of Trackers.

Text Books:

1. Merrill I.Skolnik, “Introduction to Radar Systems”, 2nd edition-TMH 1980.

2. N.S. Nagaraja, “Elements of electronic navigation, 2nd edition-TMH 1996.

<table>
<tr><td>Course Title</td><td colspan="5">Biomedical Instrumentation</td><td colspan="3">Minor Degree</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2091409</td><td rowspan="2">EC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>-</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Min</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- To Understand the functioning of Human Cell and its electrical characteristics
- To Understand the functioning of cardiovascular measurement and circulatory System of heart CO3: Describe various bioelectrodes
- To Describe Organization of cell and various potentials
- To Analyze the electrical hazards that may occur during the usage of medical instruments.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the functioning of Human Cell and its electrical characteristics
CO 2	Understand the functioning of cardiovascular measurement and circulatory System of heart
CO 3	Describe various bioelectrodes
CO 4	Describe Organization of cell and various potentials
CO 5	Analyze the electrical hazards that may occur during the usage of medical instruments.

UNIT I

Components of Medical Instrumentation System: Bio-amplifier, Static and dynamic characteristics of medical instruments. Bio-signals and characteristics. Problems encountered with measurements from human beings.

UNIT II

Organization of cell: Derivation of Nernst equation for membrane Resting Potential Generation and Propagation of Action Potential, Conduction through nerve to neuro-muscular junction.

UNIT III

Bio Electrodes: Bio-potential Electrodes-External electrodes, Internal Electrodes. Biochemical Electrodes.Mechanical function, Electrical Conduction system of the heart, Cardiac cycle. Relation between electrical and mechanical activities of the heart. Pacemaker, Defibrillator

UNIT IV

Cardiac Instrumentation Blood pressure and Blood flow measurement: Specification of ECG machine. Einthoven triangle, Standard 12-lead configurations, Therapeutic equipment, Shortwave diathermy.

Respiratory Instrumentation: Mechanism of respiration, Spirometry, Pnemuotachograph Ventilators.

UNIT V

Physiotherapy and Electrotherapy Equipment: High frequency heat therapy, Short wave Diathermy, Microwave Diathermy, Ultrasonic Therapy Unit, Electro diagnostic/ Therapeutic Apparatus, Pain relief through electrical stimulation, Diaphragm pacing by Radio-frequency for the treatment of chronic ventilator insufficiency, Bladder stimulators.

Patient electrical safety: Types of hazards, natural protective mechanism, leakage current, patient isolation, hazards in operation rooms, grounding conditions in hospital environment.

Text Books:

1. Leslie Cromwell and F.J. Weibell, "Biomedical Instrumentation andMeasurements ",E.A. Pfeiffer, PHI, 2nd Ed, 1980.
2. John G. Webster, "Medical Instrumentation, Application and Design",John Wiley,3rd Ed., 1998.

Reference Books:

1. L.A. Geoddes and L.E. Baker, " Principles of Applied Biomedical Instrumentation", John Wiley,1975.
2. R.S. Khandpur, " Hand-book of Biomedical Instrumentation", TMH, 2nd Ed.,2003.
3. Mackay, Stuart R., "Biomedical Telemetry",–John Wiley,1968.
4. M. Armugam, "Biomedical Instrumentation", Anuradha agenciespublications.

Course Title	Digital Circuits					Minor Degree		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2091410	EC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	-	--	3	40	60	100
Mid Exam Duration: 90 Min					End Exam Duration: 3Hrs			

Course Objectives:

- To provide fundamentals of number systems and Boolean Algebra.
- To learn the design of combinational and sequential circuits.
- To teach various memories and PLDs.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand various number systems and binary codes.
CO 2	Understand the postulates, theorems and properties of Boolean algebra.
CO 3	Describe the correlation between the Boolean expression and their corresponding logic diagram.
CO 4	Analyze Combinational & sequential logic circuits.
CO 5	Solve Switching functions using Programmable Logic Devices.

UNIT-I

Number Systems & Codes: Overview of number systems –complement representation of negative numbers- binary arithmetic, binary codes, code conversion, error detecting & error correcting codes –Hamming codes.

UNIT-II

Boolean Algebra and Minimization of Switching Functions: Fundamental postulates of Boolean Algebra - Basic theorems and properties –Canonical and Standard forms- Minimal SOP and POS forms ,Algebraic simplification, digital logic gates –universal gates-Multilevel NAND/NOR realizations. The K- map method, tabulation method.

UNIT-III

Combinational Logic Design: Design using conventional logic gates, Half and Full Adders, Subtractors, Serial and Parallel Adders, Encoder, Decoder, Multiplexer, De-Multiplexer, Realization of switching functions using multiplexer, Parity bit generator, Code-converters, Hazards and hazard free realizations.

UNIT-IV

Sequential Logic Design: Synchronous and Asynchronous sequential circuits, Flip-flops-Triggering and excitation tables, Flip flop conversions, shift registers, Design of Synchronous and Asynchronous counters, Ring and Johnson counters. Finite state machines (Mealy Model, Moore Model) and their representation, Designing synchronous Sequential circuits like Serial Binary adder, Sequence detector.

UNIT-V

Semiconductor Memories and Programmable Logic Devices: ROM- Internal structure, Static RAM and Dynamic RAM. Basic PLD‟s-ROM, PROM, PLA, and PAL, Realization of Switching functions using basic PLD‟s. Concept of PLD‟s like CPLDs and FPGAs.

Text Books:

1. ZVI Kohavi, Switching & Finite Automata theory –, TMH, 2ndEdition.
2. Morris Mano, "Digital Design", PHI, 3rd Edition, 2006.
3. A. Anand Kumar, "Switching Theory & Logic Design", 2008, PHI.

Reference Books:

1. R. P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
2. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition, 2006.
3. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill,1989
4. William I. Fletcher, "An Engineering Approach to Digital Design", PHI.
5. Charles H. Roth, "Fundamentals of Logic Design", Thomson Publications, 5th Edition,2004.
6. John M. Yarbrough, "Digital Logic Applications and Design", Thomson Publications,

<table>
<tr><td>Course Title</td><td colspan="5">Python Programming
(Open Elective Course -IV)</td><td colspan="3">B. Tech VII Sem (R20) CSE</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE508</td><td rowspan="2">OEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 90 Mins</td><td colspan="3">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- Understand programming skills using basics of Python language
- Acquire basics of how to use collection data types of python language.
- To Introduce the object-oriented programming concepts.
- To understand Python Libraries NumPy and Pandas.
- To design a client server model using network Programming in python.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Demonstrate and acquire knowledge on usage of Data types, operators, input and output statements in python programming.
CO 2	Identify the right sequences of python language in problem solving.
CO 3	Apply object-oriented features to solve real time applications
CO 2	Analyze the given problem and develop python program to solve the problem
CO 4	Able to use Numerical Python (NumPy) Libraryd for data processing.
CO 5	Apply network programming features of python for Internet applications

UNIT-I

Introduction: Data Types, Object References, Collection Data Types, Logical Operations, Control Flow Statements, Arithmetic Operators, Input/Output, Creating and Calling Functions.

UNIT-II

Collection Data Types: Sequence Types, Set Types, Mapping Types, Iterating and Copying Collections, Control Structures, Exception Handling, Custom Functions, Modules and packages.

UNIT-III

File Handling and OOP: Writing and Parsing Text Files, Object Oriented Approach, Concepts and Terminology, Attributes and Methods, Inheritance and Polymorphism, Using properties to control attribute access, creating complete fully integrated data types.

UNIT-IV

NumPy Basics: The NumPy ndarray, Creating ndarray, Data Types for ndarray, Operations between Arrays and Scalars, Basic Indexing and Slicing, Boolean Indexing, Universal Functions, Data

Processing using Arrays.

UNIT-V

Introduction to Internet Programming: What is Client/Server Architecture? Sockets: Communication End points, Network Programming in Python: Socket() Module Function, Socket Object Built-In Methods, creating a TCP Server, creating a TCP Client. [Text Book 4]

Text Books:

1. Programming in Python 3, A complete Introduction to Python Language by Mark Summerfield, Pearson Publications, second edition, 2018
2. Core python programming by Wesley J Chun, Prentice Hall, Second edition.
3. Python for Data Analysis by Wes McKinney, O'Reilly, First Edition.
4. Core Python Applications Programming by Wesley J. Chun, Third Edition.

Reference Books:

1. Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher.
2. Learning python, Mark Lutz, O'Reilly publications,5th edition, 2013
3. Python: The complete reference by Martin C Brown, McGraw-Hill Publication, 2018.
4. Core python programming by Dr. R. Nageswara Rao, Dreamtech press, second edition, 2018.

<table>
<tr><td>Course Title</td><td colspan="5">Cloud Computing
(Open Elective Course -IV)</td><td colspan="3">B.Tech VII Sem (R20) CSE</td></tr>
<tr><td rowspan="2">Course Code</td><td rowspan="2">Category</td><td colspan="3" rowspan="2">Hours/Week</td><td rowspan="2">Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr></tr>
<tr><td rowspan="2">20OE509</td><td rowspan="2">OEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- To explain the history of different computing paradigms.
- To Know about issues and virtualization in cloud
- To introduce the various levels of Cloud Services and applications that can be achieved by the cloud.
- To know about cloud access and security issues.

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	Recall different Computing Paradigms and overview of cloud computing.
CO 2	Understanding the Cloud Computing Architecture, network connectivity and cloud migration strategy.
CO 3	Explain and characterize different cloud deployment models, service models.
CO 4	Understanding virtualization, Programming models and Software Development in Cloud Computing.
CO 5	Understanding Cloud Service Providers AWS and Microsoft cloud Services.

UNIT-I

Computing Paradigms, Cloud Computing Fundamentals, Motivation for Cloud Computing: The Need for Cloud Computing. Defining Cloud Computing: NIST Definition of Cloud Computing, Computing Is a Service, Cloud Computing Is a Platform. Principles of Cloud computing: Five Essential Characteristics, Four Cloud Deployment Models, Three Service Offering Models, Cloud Ecosystem, Requirements for Cloud Services, Cloud Application, Benefits and Drawbacks.

UNIT-II

Cloud Computing Architecture and Management: Cloud Architecture, Anatomy of the Cloud, Network Connectivity in Cloud Computing, Applications on the Cloud, Managing the Cloud, Migrating Application to Cloud.

UNIT-III

Cloud Deployment Models: Private Cloud, Public Cloud, Community Cloud, Hybrid Cloud.

Cloud Service Models: Infrastructure as a Service, Platform as a Service, Software as a Service, Other Cloud Service Models.

UNIT-IV

Virtualization: Introduction, Virtualization opportunities, Approaches to Virtualization, Hypervisors, From Virtualization to cloud computing.

Programming Models in Cloud: Cloud Application Development Platforms: Windows Azure, Google App Engine, Force.com, Manjrasoft Aneka.

Software Development in Cloud: Introduction, Different perspectives on SaaS development, New challenges, Cloud aware software development using PaaS technology.

UNIT-V

Cloud Services : Using Amazon Web Services – Understanding AWS, AWS Components and Services, Working with the Elastic Compute Cloud (EC2), Amazon Storage Systems, Amazon Database Services, Using Microsoft Cloud Services – Exploring Microsoft Cloud Services, Defining the Windows Azure Platform.

Text Books:

1. Barrie Sosinsky, "Cloud Computing Bile" ,Wiley publishing.
2. Judith Hurwitz, R Bloor, M.Kanfman, F.Halper "Cloud Computing for Dummies", Wiley India Edition, First Edition.
3. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, "Cloud Computing: Principles and Paradigms", Wiley Publication,2011.
4. K.Chandrasekaran, Essentials of Cloud Computing, CRC Press, 2015.

Reference Books:

1. Danielle Ruest and Nelson Ruest, "Virtualization: A Beginners's Guide", McGraw Hill, 2009.
2. Tom White, "Hadoop: The Definitive Guide", O'RIELLY Media 2009.
3. Nikos Antonopoulos, Lee Gillam, Cloud Computing: Principles, Systems and Applications, Springer, 2012.

<table>
<tr><td>Course Title</td><td colspan="4">OPERATIONS RESEARCH (R20)</td><td colspan="3">OPEN ELECTIVE - IV</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE617</td><td rowspan="2">Open Elective</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>--</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hours</td></tr>
<tr><td colspan="9">Course Objectives:
The course is intended to identify and develop operations research models, understand the mathematical tools to solve optimization problems and develop a report that describes the model, the solving techniques and analyze the results.</td></tr>
<tr><td colspan="9">Course Outcome: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand various concepts of Operations research.</td></tr>
<tr><td>CO 2</td><td colspan="8">Apply linear programming to optimization techniques.</td></tr>
<tr><td>CO 3</td><td colspan="8">Discuss Transportation problem.</td></tr>
<tr><td>CO 4</td><td colspan="8">Solve Assignment problem.</td></tr>
<tr><td>CO 5</td><td colspan="8">Distinguish a game situation from a pure individual's decision problem and to explain concepts of players, strategies, payoffs, rationality.</td></tr>
</table>

UNIT I: Introduction to Operations research

Introduction, Models of Operations research, Advantages of Operations research, Limitations of Operations research

UNIT II: Linear Programming

Linear programming, Assumptions of linear programming, Properties of linear programming solution, Development of LP models, Graphical method, Simplex method.

UNIT III: Transportation Problem

Transportation problem, Mathematical model for transportation problem, Types of transportation problem, Starting solutions: North- West corner rule, Least cost method, Vogel’s approximation method.

UNIT IV: Assignment Problem

Assignment problem – Hungarian method.

UNIT V: Game Theory

Introduction to Game Theory, Properties of a Game, Characteristics of Game Theory, Classification of Games, The Maximin-Minimax Principle, Two-Person and Zero-Sum Game, Games with Mixed Strategies, Method of finding out odds.

Text books:

1. Operations Research by N.K.Tiwari, Shishir K. Shandilya Prentice-Hall of India.
2. Operations Research by R. Pannerselvam, PHI Publications, 2nd Edition, 2012

3. Fundamentals of Operations Research, Prism publishers, Ackoff Russell LSasieni Maurice W.
4. Introduction to Operations Research, Cengage Publishers, Ecker Joseph Gkupferschmid Michael.

Reference Books:

1. Engineering Optimization by Singiresu S. Rao New Age International Publishers.
2. Operations Research by Kanthi Swarup, P.K.Gupta and Manmohan, S. Chand & Sons, 2004.
3. Introduction to Operations Research, TMH Publishers, Hiller Fredrick S, Lieberman Gerald J, Nag Bodhibr.
4. Introduction to Operations Research a Computer Oriented algorithmic, Gillett Billy E.

<table>
<tr><td>Course Title</td><td colspan="4">FUNDAMENTALS OF QUANTUM COMPUTATION AND NANO PHOTONICS</td><td colspan="4">OPEN ELECTIVE - 4</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">180E2618</td><td rowspan="2">BSC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End lab Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>30</td><td>70</td><td>100</td></tr>
<tr><td colspan="5"></td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

COURSE OBJECTIVES:

1. This course outlines physically the intuitive concepts of quantum computation and nanophotonics using the concept of optical near-fields.
2. 2.Physics of information processing; quantum error correction; quantum communication, Optical near-field is an electromagnetic field that mediates the interaction between nanometric materials used for the realization of novel photonic devices, fabrication techniques, and systems.
3. Prior knowledge of quantum mechanics and photonics is helpful.

Course Outcomes: Upon completion of the course, the student will be able to:

CO1	**Explain** the concepts of Quantum mechanics.
CO2	**Understanding** the basic concepts of quantum computation.
CO3	**Identify** the different implementations of quantum computers.
CO4	**Analyze** the nanophotonics and its true nature
CO5	**Classify** the Interconnections for nanophotonics

UNIT –I: Quantum Mechanics

Introduction to Matter Waves - de Broglie Hypothesis - Heisenberg Uncertainty Principle - Schrodinger’s time independent wave equation - Significance of wave function.

UNIT –II: Quantum Computing

Basic concepts of quantum mechanics – Stern - Gerlach Experiment - Qubits – Measurements – Gates - Quantum no-cloning and Teleportation.

UNIT -III: Error Correction and Implementations

Quantum Error-Correction - three-qubit bit flip code - five-qubit code - General properties of quantum error-correction.
First Experimental Implementations - Quantum optics implementations -NMR quantum information processing.

UNIT -IV: Nanophotonics

Photons and Electrons: Similarities and Differences - Confinement – Propagation-free space, Forbidden Zone: Tunneling.

UNIT – V: Nanophotonic systems

Nanotechnology- Photonics - Nanophotonics - Optical Nanomaterials - Nanoparticle Coatings - Sunscreen Nanoparticles - Self-Cleaning Glass - Fluorescent Quantum Dots – Nanobarcodes.

Text Books:

1. Quantum Computing Basics and Concepts by **S. M. Girvin - arXiv , 2013**
2. *Principles of Nanophotonics by* Motoichi Ohtsu, Kiyoshi Kobayashi, Tadashi Kawazoe, Takashi Yatsui and Makoto Naru -New York, USA: CRC Press-Taylor & Francis Group, 2008.
3.Paras. N. Prasad, Nanophotonics. New Jersey, USA:John Wiley & Sons Inc.,2004

Reference Books:

1.Quantum Computing by **John Watrous - University of Calgary , 2006**
2.Basic Concepts in Quantum Computing by **Artur Ekert, Patrick Hayden, Hitoshi Inamori – ar Xiv , 2000**
3. An Introduction to Quantum Computing for Non-Physicists” Eleanor Rieffel FX Palo Alto Labratory and Wolfgang Polak Consultant FX Palo Alto Laboratory.

<table>
<tr><td>Course Title</td><td colspan="5">Green Chemistry and Technology</td><td colspan="3">B. Tech.
(Open Elective-IV)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE619</td><td rowspan="2">Open Elective</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Min</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
• To make students aware of how chemical processes can be designed, developed and run in a sustainable way.
o Students acquire the competence to think of chemistry as a sustainable activity</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the tolls & Principles of Green Chemistry</td></tr>
<tr><td>CO 2</td><td colspan="8">Knowledge of applications of green routes for synthesis of chemicals</td></tr>
<tr><td>CO 3</td><td colspan="8">Synthesis of biocatalysts using different techniques</td></tr>
<tr><td>CO 4</td><td colspan="8">Analyze about trends of solvent free chemical reactions</td></tr>
<tr><td>CO 5</td><td colspan="8">Better realization about reflections of Green Chemistry on sustainable development initiatives.</td></tr>
</table>

Unit-1: Fundamentals of Green Chemistry:
Discussion of the current state of chemistry and the environment and the definition of green chemistry. An introduction to the tools of green chemistry and its fundamental principles.
Learning Outcomes:
After completing this unit, the student will be able to
- Summarize the principles in green chemistry.
- Understand the importance of green chemistry in future development

Unit-2: Principles of Green Chemistry:
Prevention of waste / by-products, Hazardous products Designing of safer chemicals-Selection of appropriate solvents and starting materials- Use of protecting groups and catalysis-Designing of biodegradable products.
Learning Outcomes:
After completing this unit, the student will be able to
- Explain the importance of designing of safer chemicals.
- Interpret the need for selection of appropriate solvents and starting materials in chemical reactions.

UNIT-3: Catalysis for Green Chemistry:
Use of biocatalysts- Biochemical Oxidation, Biochemical Reduction, Modified biocatalysts-transition metal catalysis-Simmons-Smith reaction, Heak reaction, Ullmann's coupling.
Learning Outcomes:
After completing this unit, the student will be able to
- Know the use of biocatalysts.
- Explain transition metal catalysis reactions

UNIT-4: Synthesis of green chemistry

a) Solvent Free Reactions: Solvent free techniques- Reactions on solid mineral supports, Phase Transfer Catalysis- C-alkylation, N-alkylation.
b) Ultrasound assisted green synthesis Introduction to ultrasound assisted green synthesis, Hydroboration, Bouveault reaction.

Learning Outcomes:
After completing this unit, the student will be able to

- Explain solvent free reactions in green synthesis
- Understand the importance of ultrasound assisted Green synthesis

UNIT-5: Applications of Green Chemistry
Importance of Green chemistry in Sustainable development. Applications in Pharmaceutical Industry, Nanoscience, Chemical industry, Colour, Paper, polymer, Solar cells & in agriculture field.

Textbooks:

1. Engineering Chemistry, Fundamentals and Applications, Shikha Agarwal
2. Green Chemistry: Theory & Practice, Oxford University Press, Oxford publication, 1998
3. Green chemistry, Stanley E. Manahan, ChemChar Research, Inc publishers 2005.
4. Introduction to Green Chemistry, Second edition, Albert Matlack, CRC Press 2016

References:

1. Text Book of Engineering Chemistry by S.S. Dara & Mukkati S. Chand & Co Publishers, New Delhi, 2006.
2. Handbook of Green chemistry and technology, James H. Clark, Duncan J. MacQuarrie, Blackwell, Abingdon,2002
3. An Introduction Text on Green Chemistry, Indu Tucker Sidhwani, Rakesh K. Sharma, Wiley Publications
4. Green Organic Chemistry in Lecture and laboratory, Andrew P. Dicks & Michael C. Cann, T& F India publications.

Course Title	Creative Writing					OPEN ELECTIVE – IV		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE620	**HUM**	**L**	**T**	**P**	**C**	**Internal Assessment**	**External Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam: 90 Min					**End Exam Duration: 3Hrs**			

Course Objectives:

- To acquaint the learners with ideas related to creative writing including the art, the craft and the basic skills required for a creative writer
- To help learners to understand the principles of creative writing and the distinction between the literary genres
- To explain the differences in writing for various literary and social media
- To hone the creative and critical faculties of learners
- To enable learners to put into practice the various forms of creative writing that they have studied through the course

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Distinguish between the literary genres
CO 2	Write for various literary and social media
CO 3	Critically appreciate various forms of literature
CO 4	Make innovative use of their creative and critical faculties
CO 5	Seek employment in various creative fields

Unit I: Fundamentals of Creative Writing: (6 Hours)

Meaning and Significance of Creative Writing - Genres of Creative Writing: poetry, fiction, non-fiction, drama and other forms - Research for Creative Writing

Unit II: Elements of Creative Writing :(8 Hours)

Main elements of creative writing- Vocabulary improvement- often used Latin expressions in English- Idiomatic expressions.

Unit III: Forms of Creative Writing: (8 Hours)

Dialogue writing - Note making/Note taking - Short story writing - Expansion of an Idea / Proverb -Creative writing for marketing - Self-Narrative Writing

Unit IV: New Trends in Creative Writing (8 Hours)

Web Content Writing and Blog Writing- Script Writing- Journalistic Writing – Copywriting-

Graphic Novel- Flash Fiction

Unit V: Figurative Language

Literary Devices- Importance of figurative language in creative writing- Most common literary devices- Remedial grammar.

References:

- Creative Writing: A Beginner's Manual AnjanaNeira Dev. AnuradhaMarwah, Swati Pal Delhi,
  Pearson Longman, 2009.
- Abrams, M.H. Glossary of Literary Terms. Boston: Wadsworth Publishing Company,2005.
- Elements of Literature: Essay, Fiction, Poetry, Drama, Film. Robert Scholes, Nancy R. Comley, Carl H. Klaus, Michael Silverman Delhi, OUP, 2007.
- Write from the Heart: Unleashing the power of Your Creativity. Hal ZinaBennet California, New World Library,2001.
- A Guide to Writing about Literature, Sylvan Bamet, William E.Cain, New Delhi, Pearson, 2006.
- Atwood, Margaret. Negotiating with the Dead: A Writer on Writing. Cambridge: CUP,2002.
- Bell, Julia and Magrs, Paul. The Creative Writing Course-Book. London: Macmillan,2001.
- Earnshaw, Steven (Ed). The Handbook of Creative Writing. Edinburgh: EUP, 2007.
- Show, Mark. Successful Writing for Design, Advertising and Marketing. New York: Laurence King, 2012.
- Sugrman, Joseph .The Adweek Copywriting Handbook: The Ultimate Guide to WritingPowerful Advertising and Marketing Copy from One of America's Top Copywriters. NewYork: Wiley, 2009.

Cyber Resources:

http://www.chillibreeze.com/articles_various/creativewriter.asp

http://www.contentwriter.in/articles/writing/

http://www.cbse.nic.in/cw-xii/creative-writing-xii-unit-1.pdf.

<table>
<tr><td>Course Title</td><td colspan="5">Materials Management</td><td colspan="3">B. Tech.
Open Elective - IV</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE621</td><td rowspan="2">Open Elective (OEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 90 Min</td><td colspan="3">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is
• To understand how the knowledge of materials management can be an advantage to logistics and supply chain operations.
• To sensitize the students on the materials management functions – Planning, Purchase, Controlling, Storing, Handling, Packaging, Shipping and Distributing, and Standardizing
• To realize the importance of materials both in product and service.
• Use of TQM, JIT and SCM in managing materials.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Remembering the concepts of purchases, vendors, materials handling, inventory types etc.</td></tr>
<tr><td>CO 2</td><td colspan="8">An understanding of basic concepts in Materials management and modern trends inmaterials management</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze the processes of vendor management, material handling, ABC analysis andEOQ etc...</td></tr>
<tr><td>CO 4</td><td colspan="8">An understanding of principle of materials handling and evaluation of material handling performance.</td></tr>
<tr><td>CO 5</td><td colspan="8">Able to apply the techniques of inventory management.</td></tr>
</table>

Unit - I

Purchase Management: Overview, Purchase organization, Ethical Concepts in purchases, PurchaseParameters, purchase Methods. International Purchasing, International purchasing procedure.

Unit - II

Vendor Management: Vendor Evaluation - factors, advantages and disadvantages, parameters. Vendormanagement process. Recent trends in Vendor management

Unit - III

Materials Handling: Handling Principles, handling costs, unit load concept, flow pattern, materialhandling equipment's, evaluation of materials handling performance, safety in materials handling.

Unit - IV

Inventory Management: Types of Inventory, Costs Associated with Inventory, Inventory Control, Selective Inventory Control, Economic Order Quantity, ABC Analysis, Safety Stocks, Inventory Management Systems, Forecasting Techniques, Material Requirement Planning.

Unit - V

Computers in Materials Management: Introduction, Role of Computers in Materials Management: Advantages and Disadvantage of Computer in Materials Management, Materials Planning: Need for Materials Planning, Techniques of Materials Planning.

Text Book:

Material Management by K. ShridharaBhat

Reference Books:

1. Purchasing and Materials Management, P Gopalkrishnan,

2. Materials Management - An Integrated Approach, P Gopalkrishnan, M. Sundaresan, PHI.

3. Materials Management, Procedures, Text and Cases, A K Datta, PHI.

4. Production & Operation Management by K Ashwathappa, K ShridharaBhat

Course Title	Human Resource Development (Humanities & Social Science Elective Course)					B.Tech VII Sem (R20) CSE		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2006701	HSMC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 90 Minutes					End Exam Duration: 3Hrs			

Course Objectives:

- To develop capability of all individuals working in an organization in relation to their present role
- To develop team spirit.
- To develop co-ordination among different units of an organization.
- To develop organization health by continuous reveal of individual capability keeping peace with the technological changes.
- To develop better interpersonal & employer-employee relationships in an organization.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	To understand key functions in management as applied in practice.
CO 2	To understand in more specific management related areas from planning till controlling.
CO 3	To understand about the authority and responsibility, and different organizational structure..
CO 4	To understand about the role of leadership, motivation and communication in an organization.
CO 5	To understand the importance of globalization and diversity in modern organizations.

UNIT- I

Introduction to Human Resource Development: Meaning, significance and objectives of Human Resource Development, Human Resource Management and Human Resource development functions, Human Resource Development challenges.

UNIT-II

HRD Need Assessment & Designing of HRD programs: Strategic/ Organizational Analysis- Task Analysis- Person Analysis- prioritizing HRD needs, defining the objectives of HRD Intervention - Selecting the trainer - Selecting the Training methods - Preparing training material Scheduling an HRD program.

UNIT- III

Implementation &Evaluation of HRD programs: Training methods - Classroom training Approaches - Computer based Training, Purpose of HRD Evaluation- Kirkpatrick's evaluation frame work - Data collection for HRD Evaluation - Assessing the impact of HRD programs in Monetary Terms.

UNIT-IV

Career Management and Development: Introduction to Career management, meaning - Stages of life and Career Development - process of career Development - Issues in career development.

UNIT-V

HRD & Diversity: Introduction – Organizational culture – Labor Market changes and discrimination adapting to demographic changes

Text Books:

1. Jon M Werner,Randy L DeSimone : Human Resource development (Thomson/Cengage)
2. Raymond A Noe : Employee Trainee Development (Tata McGraw Hill)

Reference Books:

1. John P. Wilson Human Resource Development (Kogan Page Business Books)
2. Tripathi P.C : Human Resource Development (Sultan Chand & Sons)
3. Uday Kumar Haldar : Human Resource Development (Oxford)

<table>
<tr><td>Course Title</td><td colspan="5">Digital Marketing
(Humanities & Social Science Elective Course)</td><td colspan="3">B.Tech VII Sem (R20) CSE</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2006702</td><td rowspan="2">HSMC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- To provide foundation in the key concepts on digital marketing.
- Understand how and why to use digital marketing for multiple goals within a larger marketing and/or media strategy.
- Learn to develop, evaluate, and execute a comprehensive digital marketing strategy and plan.
- Understand the major digital marketing channels - online advertising: Digital display, video, mobile, search engine, and social media
- Learn how to measure digital marketing efforts and calculate ROI

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Analyze the confluence of marketing, operations, and human resources in real-time delivery.
CO 2	Demonstrate cognitive knowledge of the skills required in conducting online research and research on online markets, as well as in identifying, assessing and selecting digital market opportunities.
CO 3	Explain emerging trends in digital marketing and critically assess the use of digital marketing tools by applying relevant marketing theories and frameworks.
CO 4	Investigate and evaluate issues in adapting to globalized markets that are constantly changing and increasingly networked.
CO 5	Interpret the traditional marketing mix within the context of a changing and extended range of digital strategies and tactics.

UNIT - I

Understanding Digital Marketing Concept, Components of Digital Marketing, Need and Scope of Digital Marketing, Benefits of Digital Marketing, Digital Marketing Platforms and Strategies, Comparison of Marketing and Digital Marketing, Digital Marketing Trends.

UNIT - II

Channels of Digital Marketing: Digital Marketing, Website Marketing, Search Engine Marketing, Online Advertising, Email Marketing, Blog Marketing, Social Media Marketing, Mobile Marketing, Migrating from Traditional Channels to Digital Channels. Marketing in the Digital Era Segmentation – Importance of Audience Segmentation, How Different Segments use Digital Media - Digital Media for Customer Loyalty.

UNIT - III

Digital Marketing Plan: Need of a Digital Marketing Plan, Elements of a Digital Marketing Plan – Marketing Plan, Executive Summary, Mission, Situational Analysis, Opportunities and Issues, Goals and Objectives, Marketing Strategy, Action Plan, Budget, Writing the Marketing Plan and Implementing the Plan.

UNIT - IV

Search Engine Marketing and Online Advertising: Importance of SEM, Understanding Web Search – Keywords, HTML Tags, Inbound Links, Online Advertising vs. Traditional Advertising, Payment Methods of Online Advertising – CPM (Cost-per-Thousand) and CPC (Cost-per-Click), Display Ads - Choosing a Display Ad Format, Landing Page and its Importance.

UNIT - V

Social Media Marketing: Understanding Social Media, Social Networking with Face book, LinkedIn, Blogging as a Social Medium, Social Sharing with YouTube. Measurement of Digital Media: Analyzing Digital Media Performance, Analyzing Website Performance, Analyzing Advertising Performance.

Text Books:

1. Seema Gupta, Tata McGraw Hill.
2. Dave Chaffey, Pearson Education
3. Dr Antorny Puthussery

Reference Books:

1. Kevin Hartman, Digital Marketing Analytics,
2. Digital Marketing – Self learning management series, Vibrant Publishers
3. Digital Marketing, Vandana Ahuja, Oxford publishing house
4. Fundamentals of Digital Marketing, Puneet Singh Batia – Pearson Education
5. Digital Marketing by Seema Gupta (IIM-B)
6. Digital Marketing: Strategy, Implementation¬ & Practice by Dave Chaffey & Fiona Ellis Chad wick
7. Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation - Damian Ryan and Calvin Jones.

<table>
<tr><td>Course Title</td><td colspan="4">Project Management
(Humanities & Social Science Elective Course)</td><td colspan="3">B.Tech VII Sem (R20) CSE</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2006703</td><td rowspan="2">HSMC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- To impart the basic concepts of Project selection.
- To develop an understanding of Project Planning and design, construction and execution, monitoring and control, completion.
- To achieve the Project's main goal within the constraints.
- To optimize the allocated necessary inputs.
- To shape and reform the client's vision or tone got late with the masregards the project's objectives.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Remembering and recalling the principles of project management and methods involved in the process of project management.
CO 2	UnderstandingofProjectPlanning,design,construction,execution,maintaining and controlling
CO 3	Applying techniques in Project Evaluation, Scheduling And Controlling.
CO 4	Classifying and analysis risks in Project management and project scheduling

UNIT-I

Introduction to Project Management: Need for Project management, Taxonomy of project, Project life cycle, Project management Process, Principles of Project Management. Project Identification and Selection, Pre – feasibility study, Project Planning Process, Resources allocation, Project Break-even Point.

UNIT- II

Financial Evaluation of Projects: Cost of the Project, Means of finance, Financial Evaluation of projects – Payback period method, Accounting Rate of Return method, Net Present Value method, Internal Rate of Return method, Benefit Cost Ratio method (Profitability Index), (simple Problems).

UNIT-III

Project Risk & Quality Management: Introduction, Role of Risk management, Risk Identification – Steps in risk management –, Risk analysis (Sensitivity Analysis, Probability Analysis, Mean – Variance Analysis Decision trees, Simulation), Techniques for managing risk. Project Quality Management And ValueEngineering:Quality,Quality Concepts and Value Engineering.

UNIT-IV

Project Scheduling (Network Analysis): Development of Project network, Timeestimation, Determination of the critical Path, PERT Model, Project Crashing.(Simple Problems).

UNIT-V

Project Execution & PMS: Process Of Project Execution and Control, Project Management Information System (PMIS), Project Performance Measurement and Evaluation (PPME).

ProjectManagementSoftware: Essential Requirement of Project Management Software, Common Features available in most of the project management software.

Text Books:

1. Project management Best Practices: Achieving Global Excellence by Harold Kerzner; John Wiley & Sons; 3rd edition.
2. Project Management: Engineering, Technology and Implementation: united states Edition by Avraham Shtub and Jonathan F.Bard, Pearson; 1st edition.
3. The Essentials of Project Management by Dennis Lock; Routledge.
4. PrasannaChandra,Projects,TataMcGrawHill.
5. NagarajanK,ProjectManagement4thedition,NewAgeInternational(P)Ltd.
6. LSSrinath,PERT/CPM,AffiliatedEast-WestPress2005.

Reference Books:

1. Project management by Stephen Hartley; Routledge, 4th Edition.
2. Project management: a systems Approach to Planning, Scheduling, and controlling by Harold Kerzner; Wiley; 12th edition.
3. Project Management & Appraisal by Sitangshu Khatua; published by Oxford University.
4. NicholasJ.M.&SteynH.,ProjectManagement,Elsevier,Himalayapublications.
5. Narendra Singh, Project Management and Control,HPH,2003.
6. Harvey Maylor, Project Management, Pearson Education.
7. Panneer selvam Senthil kumar,Project Management, PHI.

<table>
<tr><td>Course Title</td><td colspan="4">Big Data Technologies / NASSCOM Courses</td><td colspan="3">B.Tech VII Sem (R20) CSE</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2005710</td><td rowspan="2">Skill Oriented Course</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>2</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5"></td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- Optimize business decisions and create competitive advantage with Big data analytics.
- Practice java concepts required for developing map reduce programs.
- Impart the architectural concepts of Hadoop and introducing map reduce paradigm.
- Practice programming tools PIG and HIVE in Hadoop ecosystem.
- Implement best practices for Hadoop development.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the installation of VMW is and PIG.
CO 2	Understand and apply the setting up and Installing Hadoop in its three operating modes.
CO 3	Implement the file management tasks in Hadoop.
CO 4	Understand Map Reduce Paradigm.
CO 5	Understand Pig Latin scripts sort, group, join, project, and filter your data.

LIST OF EXPERIMENTS

1. A. To study of Big Data, Why is Big Data, Why Big Data is important?

   B**.** To Study of Big Data Analytics and Hadoop Architecture.

2. To study HDFS Commands.

3. Installation of VMW is to setup the Hadoop environment and its ecosystems.

4. A. Perform setting up and Installing Hadoop in its three operating modes.

   I. Standalone.

   II. Pseudo distributed.

   III. Fully distributed.

   B. Use web based tools to monitor your Hadoop setup.

5. Implementing the basic commands of LINUX Operating System File/Directory creation, deletion, and update operations.

6. Implement the following file management tasks in Hadoop:
    I. Adding files and directories
    II. Retrieving files
    III. Deleting files

   Hint: A typical Hadoop work flow creates data files (such as log files) elsewhere and copies them into HDFS using one of the above command line utilities.

7. Run a basic word count Map Reduce program to understand Map Reduce Paradigm.
8. Write a Map Reduce program that mines weather data.

   Hint: Weather sensors collecting data every hour at many locations across the globe gather a large volume of log data, which is a good candidate for analysis with Map Reduce, since it is semi structured and record-oriented.

9. Implement matrix multiplication with Hadoop Map Reduce.
10. Installation of PIG.
11. Write Pig Latin scripts sort, group, join, project, and filter your data.
12. A. Run the Pig Latin Scripts to find Word Count.
    B. Run the Pig Latin Scripts to find a max temp for each and every year.
13. HIVE OPERATIONS

    Use Hive to create, alter, and drop databases, tables, views, functions, and indexes.

Text Books:

1. Tom White, Hadoop, "The Definitive Guide" , 3rd Edition, O'Reilly Publications,2012.
2. Dirk deRoos, Chris Eaton, George Lapis, Paul Zikopoulos, Tom Deutsch, "Undetstanding Big Data Analytics for Enterprise class Hadoop and StreamingData", 1st Edition, TMH, 2012.
3. Bart Baesens, Analytics in a Big Data World: The Essential Guide to DataScience and its Applications, Wiley Publications, 2014.
4. Big Data Technologies and Applications, Borko Furht, Flavio Villanustre, Springer.

Reference Books:

1. Hand Book of Big Data Technologies, Albert Y. Zomaya, Sherif Sakr, Springer.
2. Big Data Analytics: Tools and Technology for Effective Planning, Arun K. Somani, Ganesh Chandra Deka, CRC Press.
3. Big Data, Big Analytics, Michael Minelli, Michele Chambers, Ambiga Dhiraj, John Wiley and Sons.

Course Title	Internship					B.Tech VII Sem (R20) CSE		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2039711	**INT**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		--	**--**	**--**	**3**	**100**	**--**	**100**
Internal Assessment								

Course Objectives:

- Develop and improve business skills in communication, technology, quantitative reasoning, and teamwork.
- Observe and participate in business operations and decision-making.
- Meet professional role models and potential mentors who can provide guidance, feedback, and support.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Assess interests and abilities in their field of study and Integrate theory and practice.
CO 2	Develop communication, interpersonal and other critical skills in the job interview process.
CO 3	Acquire employment contacts leading directly to a full-time job following graduation from college.
CO 4	Identify and carry out performance objectives related to their job assignment.

B.Tech VIII SEM CSE (R20)

<table>
<tr><td>Course Title</td><td colspan="4">Major Project</td><td colspan="3">B.Tech VIII Sem (R20) CSE</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039801</td><td rowspan="2">PROJ</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>12</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Internal Assessment:40</td><td colspan="4">External Assessment:60</td></tr>
</table>

Course Objectives:

- Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
- Acquire and apply new knowledge as needed, using appropriate learning strategies.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Demonstrate a sound technical knowledge of their selected project topic.
CO 2	Understand problem identification, formulation and solution
CO 3	Design engineering solutions to complex problems utilizing a systems approach.
CO 4	Communicate with engineers and the community at large in written an oral form
CO 5	Demonstrate the knowledge, skills and attitudes of a professional engineer

GUIDELINES FOR PROJECT

The prime objective of the project work is to imbibe students with technical, analytical and innovative ideas. The students will able to learn theoretical and practical approaches pertaining to software applications development. A team of 4-5 students formed as a group and work under the supervision of a departmental faculty. Associating the students to solve real world problems identified within the department. The project work normally includes:

1. Literature survey on existing problem/ topic from viable sources.
2. Eliciting the problem-solving approach/methodologies and making the feasibility study.
3. The team should perform an extensive software requirements analysis.
4. Preparing an abstract on the selected topic and present before Departmental Review Committee (DRC).
5. Preparing a roadmap to design, analyze, implement, evaluate/test considering functional, non- functional aspects and finally, deploy the application/product/software service.
6. Detailed Analysis/Design /Simulation as needed.
7. Final development of product/process conducting testing and specifying the results, conclusions and future scope.

8. Preparing a project report in the standard format for being evaluated by the Department Review Committee (DRC).
9. Final Project presentation / execution before Departmental Review Committee (DRC)

<table>
<tr><td>Course Title</td><td colspan="5">Internship
(6 Months)</td><td colspan="3">B.Tech VII Sem (R20) CSE</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2039801</td><td rowspan="2">INT</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>--</td><td>--</td><td>--</td><td>12</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Internal Assessment: 40</td><td colspan="4">External Assessment: 60</td></tr>
<tr><td colspan="9">Course Objectives:
● Develop and improve business skills in communication, technology, quantitative reasoning, and teamwork.
● Observe and participate in business operations and decision-making.
● Meet professional role models and potential mentors who can provide guidance, feedback, and support.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Assess interests and abilities in their field of study and Integrate theory and practice.</td></tr>
<tr><td>CO 2</td><td colspan="8">Develop communication, interpersonal and other critical skills in the job interview process.</td></tr>
<tr><td>CO 3</td><td colspan="8">Acquire employment contacts leading directly to a full-time job following graduation from college.</td></tr>
<tr><td>CO 4</td><td colspan="8">Identify and carry out performance objectives related to their job assignment.</td></tr>
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