PRASAD V POTLURI SIDDHARTHA INSTITUTE OF TECHNOLOGY
(Autonomous)

ACADEMIC RULES &REGULATIONS (PVP20)
and
B.Tech Course Structure, Syllabus

Applicable for the batch of students admitted from the Academic Year 2020-2021

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

PRASAD V. POTLURI SIDDHARTHA INSTITUTE OF TECHNOLOGY
(Autonomous)
AICTE approved, NBA & NAAC A+ Accredited, An ISO 9001:2015 certified Institution
Permanently Affiliated to Jawaharlal Nehru Technological University
Kakinada
Kanuru, Vijayawada -520 007, Andhra Pradesh
Phone:0866 2581699
e-mail: principal@pvpsiddhartha.ac.in
www.pvpsiddhartha.ac.in

w.e.f. A.Y 2020 – 2021

PREFACE

PVP Siddhartha Institute of technology, established in 1998, is one of the seventeen educational institutions sponsored and run by Siddhartha Academy of General & Technical Education. The 250 members of the Academy are a group of industrialists, educationists, auditors and philanthropists with vast experience in their respective fields and above all with an ardent desire to spread quality Education. All the academic organizations of Siddhartha Academy stand symbolic of the pragmatic vision of its founders. PVP Siddhartha Institute of Technology has the advantage of inheriting the higher academic standards. The college is approved by AICTE and is permanently affiliated to JNTUK. It is certified by ISO 9001-2015 for its quality standard. All the UG Programs are accredited by the National Board of Accreditation and NAAC with A^+ grade. It is an Autonomous institute.

The curriculum is revised continuously to address the challenges of industry and academia and to foster the global competencies among the students. The curriculum is revised thrice since 2012. The present curriculum(PVP20) is designed incorporating the features such as outcome based approach, encouraging self-learning through MOOCs platforms i.e., Swayam, COURSERA, EDX, NPTEL, etc., Transformation of creative ideas into a prototype through Internship & Project, enhancing depth & breadth by introducing more number of programs, open electives in core and multi- disciplinary areas, offering courses by industry experts to improve Industry Institute Interaction in addition to internships at industry and introduction of wide range of value added courses beyond curriculum to choose according to their interest to enhance their employability skills.

Institute Vision

To provide rich ambience for Academic and Professional Excellence, Research, Employability skills, Entrepreneurship and Social responsibility.

Institute Mission

To empower the students with Technical knowledge, Awareness of up-to-date technical trends, Inclination for research in the areas of human needs, Capacity building for Employment / Entrepreneurship, Application of technology for societal needs.

Quality Policy

At PVPSIT, We commit ourselves to offer Quality professional education in engineering & Management by adhering to applicable statutory and regulatory requirements and through continuous improvement in the Quality of our services by,

- Regular up gradation of knowledge and skills of faculty
- Improving the teaching methods and strategies
- Providing state of art infrastructure
- Recruiting competent faculty and maintaining prescribed Teacher Student ratio
- Improving the employability of students
- Enhanced Collaboration with industry and institutions of National Repute

- **DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**

VISION OF THE DEPARTMENT

To be a centre of excellence in academics and research in Computer Science and Engineering and take up challenges for the benefit of society.

MISSION OF THE DEPARTMENT

- Impart professional education through best curriculum in harmony with the industry needs.
- Inculcate ethics, research capabilities and team work in the young minds so as to put efforts to the advancement of the nation.
- Strive for student achievement and success with leadership qualities and preparing them for continuous learning in the global environment.

PROGRAM EDUCATIONAL OBJECTIVES	
PEO	**STATEMENTS**
PEO I	The graduates of the program will excel in the concepts of basic engineering and advanced concepts of computer science engineering.
PEO II	The graduates of the program will be professional in computing industry or pursuing higher studies.
PEO III	The graduates of the program will excel in team work, ethics, communication skills and contribute to the benefit to the society.

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

PO 11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one"s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PROGRAM SPECIFIC OUTCOMES (PSOs)	
PSO1	Apply the Knowledge of Computing Skills in building the Software Systems that meet the requirements of Industry and Society.
PSO2	Apply the Knowledge of Data Engineering and Communication Technologies for Developing Applications in the Domain of Smart and Intelligent Computing.

QUALITY POLICY

At PVPSIT, We commit ourselves to offer Quality professional education in engineering & Management by adhering to applicable statutory and regulatory requirements and through continuous improvement in the Quality of our services by,

- Regular up gradation of knowledge and skills of faculty
- Improving the teaching methods and strategies
- Providing state of art infrastructure
- Recruiting competent faculty and maintaining prescribed Teacher Student ratio
- Improving the employability of students
- Enhanced Collaboration with industry and institutions of National Repute

CONTENTS

Engineering UG Programmes

Introduction

The redesigned curriculum focused on up skilling the graduates on the skills relevant to the need and demands of the industry. The curriculum mandates students to take up five skill courses which are relevant to the industry from second year onwards, two basic level skill courses, one on soft skills and other two on advanced level skill courses. The students are also given the option of choosing between skill courses offered by the Institute and a certificate course offered by industry, a professional body, APSSDC or any other accredited body.

Another major change brought in the curriculum is the introduction of B.Tech. with Honors or a B.Tech with a Minor. This is to give an opportunity for the fast learners to earn additional credits either in the same domain or in a related domain, making them more proficient in their chosen field of discipline or be a graduate with multidisciplinary knowledge and job ready skills.

Mandatory Internship, both industry and social, is included in the revised curriculum that aims at making engineering graduates connect with the needs of the industry and society at large. It will be mandatory for the students to intern in the industry/field for four to six weeks during the summer vacation and also in the final semester to acquire the skills required for job.

The redesigned curriculum offers academic flexibility by introducing a pool of inter-disciplinary and job-oriented skill courses which are integrated in to the curriculum of each branch of engineering, from which a student can pick his choice. Flexibility is not only given to students in the choices of courses, but flexibility is given in choosing courses either from the pool of courses offered by the concerned department or in choosing the courses offered by APSSDC or by any other reputed organization/professional body which offers with certification, as decided by respective BoS. Hence, the students are given wide choice and flexibility to undertake courses, while at the same time offering relevance to the interest of individual student in their own context. The curriculum also gives flexibility to the institution in offering a variety of courses to the students of a particular discipline. The Board of Studies is empowered to identify as many tracks and pools as possible in emerging technologies and industrial relevance, and also in humanities and sciences.

1. SHORT TITLE AND COMMENCEMENT

a. The regulations listed under this head are common for all degree level undergraduate programmes (B.Tech.), offered by the college with effect from the academic year 2020-21 and they are called as “PVP20” regulations.

b. The regulations here under are subjected to amendments as may be made by the Academic Council of the college from time to time, keeping in view of the recommendations of the Board of Studies. Any or all such amendments will be effective from such date and to such batches of candidates including those already undergoing the programme, as may be decided by the Academic Council.

2. DEFINITIONS

a. “**Commission**” means University Grants Commission(UGC);

b. “**Council**” means All India Council for Technical Education(AICTE);

c. “**University**” means Jawaharlal Nehru Technological University Kakinada(JNTUK);

d. “**College**” means Prasad V Potluri Siddhartha Institute of Technology, Vijayawada;

e. An **Academic Programme** means any combination of courses and/or requirements leading to award of a degree.

f. “**Course**” means a subject either theory or practical identified by its course title and code number and which is normally studied in a semester.

g. “**Degree**” means an academic degree conferred by the university upon those who complete the under graduate curriculum.

h. “**MOOC**” means Massive Open Online Course

i. “**Regular Students**” means students enrolled into the four year programme in the first year.

j. “**Lateral Entry Students**” means students enrolled into the four year programme in the second year.

3. ACADEMIC PROGRAMMES

3.1 Nomenclature of Programmes

3.1.1 The nomenclature and its abbreviation given below, shall continue to be used for the Degree programmes under the University, as required by the Council and the Commission:

Bachelor of Technology (B. Tech)

Besides, the name of specialization shall be indicated in brackets after the abbreviation, for example, engineering degree in Mechanical Engineering programme is abbreviated as B.Tech (Mechanical Engineering).

3.1.2 Bachelor of Technology (B. Tech.) degree programme is offered in:

1. Civil Engineering(CE)
2. Computer Science and Engineering(CSE)
3. Computer Science and Engineering(AI & ML)
4. Computer Science and Engineering(Data Science)
5. Electronics and Communication Engineering(ECE)
6. Electrical and Electronics Engineering(EEE)
7. Information Technology(IT)
8. Mechanical Engineering(ME)

4. DURATION OF THE PROGRAMMES

4.1 Normal Duration

4.1.1. The duration of an academic programme shall be four years consisting of eight semesters.

4.1.2. The duration of the programme for lateral entry students who are admitted in II year shall be three years that consists of six semesters.

4.2 Maximum Duration

4.2.1 The maximum period for which a student can take to complete a full time academic programme shall be double the normal duration of the programme, i.e., for regular students eight years, for lateral entry students six years.

4.3 Minimum Duration of a Semester

Each semester consists of a minimum of 90 instruction days with about minimum 20 and maximum 33 contact hours per week.

5. ADMISSION CRITERIA

The eligibility criteria for admission into UG Engineering programmes are as per the norms approved by Government of Andhra Pradesh from time to time. The sanctioned seats in each programme in the college are classified into CATEGORY- A, and CATEGORY-B at I year level and only CATEGORY-A at Lateral Entry II year level.

The percentages of Category–A, Category-B and Lateral Entry Seats are decided from time to time by the Government of Andhra Pradesh.

5.1 CATEGORY – A Seats

Category - A seats are filled as per the norms approved by the Government of Andhra Pradesh.

5.2 CATEGORY – B Seats

Category - B seats are filled by the College as per the norms approved by the Government of Andhra Pradesh.

5.3 CATEGORY - Lateral Entry Seats

Lateral entry candidates shall be admitted into the III semester directly as per the norms approved by Government of Andhra Pradesh.

6. CREDIT SYSTEM AND GRADE POINTS

6.1 Credit Definition

'Credit' means quantified and recognized learning. Credit is measured in terms of contact hours per week in a semester. Typically one credit is given to:

(a) Theory/Tutorial course conducted for one contact period.

(b) Laboratory course conducted for two contact periods.

Each course is assigned a certain number of credits depending upon the number of contact hours (Lectures/Tutorials/Practical) per week.

The curriculum of the eight semesters B.Tech program is designed to have a total of 160 credits for the award of B.Tech degree.

For lateral entry students, the curriculum of six semesters B.Tech program is designed to have a total of 121 credits for the award of B.Tech degree.

6.2 Semester Course Load

The average course load shall be fixed at 20 credits per semester with its minimum and maximum limits being set at 12 and 23 credits.

6.3 Grade Points and Letter Grade for a Course

The grade points and letter grade will be awarded to each course based on student's performance as per the grading system shown in the Table.

Table: Grading System for B. Tech Programme (PVP20 Regulations)

Grades and Grade Points (PVP20 Regulations)

Theory / Drawing (Max-100)	Laboratory/ Mini Project/ Internship etc. (Max – 50)	Level	Grade Point	Letter Grade
≥ 90	≥ 45	Outstanding	10	A+
≥ 80 to ≤ 89	≥ 40 to ≤ 44	Excellent	9	A
≥ 70 to ≤ 79	≥ 35 to ≤ 39	Very Good	8	B
≥ 60 to ≤ 69	≥ 30 to ≤ 34	Good	7	C
≥ 50 to ≤ 59	≥ 25 to ≤ 29	Fair	6	D
≥ 40 to ≤ 49	≥ 20 to ≤ 24	Satisfactory	5	E
< 40	< 20	Fail	0	F (FAIL)
ABSENT	ABSENT	ABSENT	0	AB

* For Major Project same (%) percentages will be followed for grading

6.4 Semester Grade Points Average(SGPA)

The performance of each student at the end of each semester is indicated in terms of SGPA calculated as shown in equation (1)

$$\text{SGPA} = \frac{\sum (CR \times GP)}{\sum CR \text{ (for all courses offered in the semester)}} \quad \text{.....(1)}$$

Where CR= Credits of a course

GP = Grade points awarded for a course
$\sum CR$ = Summation of all the courses offered in the semester

6.5 Cumulative Grade Point Average (CGPA)

The Cumulative Performance of each student at the end of each semester is indicated in terms of CGPA which is calculated as shown in equation (2).

$$CGPA = \frac{\sum CR \ X \ GP}{\sum CR(for\ all\ courses\ offered\ upto\ that\ semester\ /entire\ program)} \text{-- (2)}$$

Where CR = Credits of a course

GP = Grade points awarded for a course

Percentage equivalent of CGPA = (CGPA – 0.75) * 10

7. CURRICULUM FRAMEWORK

7.1. Regular and Honors B.Tech Programmes of all Branches

1. Award of the Degree: A student will be declared eligible for the award of

   B. Tech. degree if he/she fulfils the following:

   i. Pursues a course of study in not less than four and not more than eight academic years.

   ii. After eight academic years from the year of their admission, he/she shall forfeit their seat in B. Tech course and their admission stands cancelled.

   iii. Registers for 160 credits and must secure all the 160 credits.

   iv. A student shall be eligible for the award of B.Tech degree with Honors or Minor if he / she earns 20 credits in addition to the 160 credits. A student shall be permitted to register either for Honors or for Minor and not for both simultaneously.

2. Structure of the Undergraduate Engineering program:

Every course of B.Tech. Program shall be placed in one of the nine categories as listed in table below:

S. No.	Category	Code	Suggested breakup of Credits (APSCHE)	Suggested breakup of Credits (AICTE)
1	Humanities and social science including Management courses	HSMC	10.5	12
2	Basic Science courses	BSC	21	25
3	Engineering Science courses	ESC	24	24
4	Professional core Courses	PCC	51	48
5	Open Elective Courses	OEC	12	18
6	Professional Courses Elective	PEC	15	18
7	Internship, project work seminar, Community Service Project	PROJ	16.5	15
8	Mandatory courses	MC	Non-credit	Non-credit
9	Skill Oriented Courses	SC	10	-
Total Credits			160	160

3. Assigning of Credits:

   1 Hr. Lecture (L) per week - 1 credit

   1 Hr. Tutorial (T) per week - 1 credit

   1 Hr. Practical (P) per week - 0.5 credits

   2 Hours Practical (Lab)/week - 1 credit

4. There shall be mandatory student induction program for fresher's, with a three-week duration before the commencement of first semester. Physical activity, Creative Arts, Universal Human Values, Literary, Proficiency Modules, Lectures by Eminent People, Visits to local Areas, Familiarization to Dept./Branch & Innovations etc., shall be included in the guidelines issued by AICTE

5. All undergraduate students shall register for NCC/NSS activities. A student will be required to participate in an activity for two hours in a week during second and third semesters. Grade shall be awarded as Completed or Not Completed in the mark sheet on the basis of participation, attendance, performance and behavior, and it is treated as student practice course . If a student gets an unsatisfactory Grade, he/she shall repeat the above activity in the subsequent years, in order to complete the degree requirements.

6. Courses like Environmental Sciences, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge etc., shall be included in the curriculum as non-credit mandatory courses. Environmental Sciences is to be offered compulsorily as mandatory course for all branches. A student has to secure 40% of the marks allotted in the internal evaluation for passing the course. No marks or letter grade shall be allotted for all mandatory non-credit courses.

7. Institution may swap some of the courses between first and second semesters to balance the workload.

8. The concerned Board of studies can assign tutorial hours to such courses wherever it is necessary, but without change in the total number of credits already assigned for semester.

9. There shall be 05 Professional Elective courses and 04 Open Elective courses. All the Professional & Open Elective courses shall be offered for 03 credits, wherever lab component is involved it shall be (2-0-2) and without lab component it shall be (3-0-0). If a course comes with a lab component, that component has to be cleared separately. The concerned BOS shall explore the possibility of introducing virtual labs for such courses with lab component.

10. All Open Electives are offered to students of all branches in general. However, a student shall choose an Open Elective from the list in such a manner that he/she has not studied the same course in any form during the Programme.

11. A student shall be permitted to pursue up to a maximum of two elective courses under MOOCs during the Programme. Each of the courses must be of minimum 12 weeks in duration. Attendance will not be monitored for MOOC courses. Student has to pursue and acquire a certificate for a MOOC course only from the organizations/agencies approved by the BoS in order to earn the 3 credits. The Head of the department shall notify the list of such courses at the beginning of the semester.

12. The college shall invite registration forms from the students at the beginning of the semester for offering professional and open elective courses. There shall be a limit on the minimum and maximum number of registrations based on class/section strength.

13. Students shall undergo mandatory summer internships for a minimum of four to six weeks duration at the end of second and third year of the Programme. There shall also be mandatory full internship in the final semester of the Programme along with the project work.

14. There shall be 05 skill-oriented courses offered during III to VII semesters. Among the five skill courses, four courses shall focus on the basic and advanced skills related to the domain courses and the remaining one shall be a soft skills course.

15. Under graduate Degree with Honors / Minor shall be issued by the institute to the students who fulfil all the academic eligibility requirements for the B. Tech program and Honors / Minor program. The objective is to provide additional learning opportunities to academically motivated students.

16. Assessment: The performance of a student in each semester shall be evaluated subject wise with a maximum of 100 marks for theory and 50 marks for practical subject. The distribution shall be 30 marks for Internal Evaluation and 70 marks for the End Semester Theory Examinations. 15 marks for Internal Evaluation and 35 marks for the

End Semester practical Examinations A student has to secure not less than 35% of marks in the end semester examination and minimum 40% of marks in the sum total of internal and end semester examination marks to earn the credits allotted to each course. Detailed guidelines for continuous evaluation shall be planned by concerned combined BOS of the Universities.

17. **Attendance Requirements**:

i. A student shall be eligible to appear for end semester examinations if he/she acquires a minimum of 75% of attendance in aggregate of all the subjects in a semester.

ii. Shortage of Attendance below 65% in aggregate shall in NO case be condoned.

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

iv. Students whose shortage of attendance is not condoned in any semester are not eligible to take their end semester examination of that class and their registration shall stand cancelled.

v. A student will not be promoted to the next semester unless he satisfies the attendance requirements of the present semester, as applicable. They may seek readmission for that semester when offered next.

vi. A stipulated fee shall be payable towards condonation of shortage of attendance to the college. A student is eligible to write the semester end examinations if he acquires 75% of attendance in aggregate of all the subjects.

7.2 General Issues

7.2.1 Curriculum framework is important in setting the right direction for a degree programme as it takes into account the type and quantum of knowledge necessary to be acquired by a student in order to qualify for the award of degree in his/her chosen branch or specialization.

7.2.2 Besides, this also helps in assigning the credits for each course, sequencing the courses semester-wise and finally arriving at the total number of courses to be studied and the total number of credits to be earned by a student in fulfilling the requirements for conferment of degree.

7.2.3 Each theory course shall consist of five units.

7.3 Curriculum Structure

The curriculum is designed to facilitate B. Tech (Honors) and B.Tech (Major, Minor) incorporates courses required to attain the expected knowledge, skills and attitude by the time of graduation as per the needs of the stakeholders. The curriculum structure consists of various course categories (as described in 7.3.1 to7.3.5) to cover the depth and breadth required for the programme and for the attainment of programme outcomes of the corresponding programme.

7.3.1 Institutional Core

Institutional Core consists of the courses required for all UG Engineering

Programmes offered in this college. The courses offered under this category cover the required knowledge in the following areas:

a) **Basic Sciences:**
Basic Science courses include Engineering Physics, Applied Physics, Engineering Physics Lab, Applied Physics Lab Engineering Chemistry, Engineering Chemistry Lab, and Engineering Mathematics, etc.

b) **Engineering Sciences:**
Engineering Science courses include Problem Solving and Programming, AI Tools, Internet of Things, Design Thinking, Basic Electrical and Electronics Engineering, Engineering Graphics, Problem Solving & Programming Lab, Basic Electrical & Electronics Engineering Lab, AI Tools Lab, Internet of Things Lab, Design Thinking Lab and Basic Workshop, etc.

c) **Humanities and Social Sciences:**
Humanities and Social Science Courses consist of Communicative English I, Communicative English II, HS Elective, Communicative English-I Lab and Communicative English-II Lab, etc.

7.3.2 Elective Courses

Elective courses are offered across the programmes to enhance the knowledge breadth and professional competency of the students.

Courses	Branch Specific	Compulsory
Elective courses	Professional Electives	Supportive to the discipline courses with expanded scope in a chosen track of specialization or cross track courses
	HS Management Elective	Nurture the student interests in management courses.
	Open Electives	Common to all disciplines that helps general interest of a student

7.3.3 Professional Core

The Professional core consists of set of courses considered which are necessary for the students of the specific programme. The courses under this category satisfy the Programme Specific Criteria prescribed by the appropriate professional societies.

7.3.4 Project

In the final semester, the student should mandatorily undergo internship and in parallel he/she should work on a project with well-defined objectives.

7.3.5 Mandatory Learning Courses

According to the guidelines given by statutory bodies, Courses on Environmental Science, Constitution of India and Engineering Ethics, Life Sciences for Engineers and Life Sciences for Engineers Lab shall be offered. Induction program shall be offered in I semester for all the branches.

7.3.6 Honors Programme

In order to obtain honors degree students shall earn additional 20 credits in addition to the 160 credits for obtaining the UG degree. Students can register for additional courses by satisfying the pre-requisite course(s) to a maximum of 8 credits in each of the semesters from IV semester onwards along with the regular semester courses as prescribed. There is no minimum limit to the credits for taking additional courses.

1. Students of a Department/Discipline are eligible to opt for Honors Programme offered by the same Department/Discipline.

   - A student shall be permitted to register for Honors program at the beginning of 4th semester provided that the student must have acquired a minimum of 8.0 CGPA up to the end of 2nd semester without any backlogs. In case of the declaration of the 3rd semester results after the commencement of the 4th semester and if a student fails to score the required minimum of 8 CGPA, his/her registration for Honors Programme stands cancelled and he/she shall continue with the regular Programme.
   - An SGPA and CGPA of 8.0 and above has to be maintained in the subsequent semesters in major degree without any backlogs in order to keep the Honors degree registration active.
   - Should both the SGPA and CGPA of major degree fall below 8.0 in major degree at any point after registering for the Honors; the Honors degree registration will cease to be active.

2. Students can select the additional and advanced courses from their respective branch in which they are pursuing the degree and get an honors degree in the same. e.g. If a Mechanical Engineering student completes the selected advanced courses from same branch under this scheme, he/she will be awarded B.Tech. (Honors) in Mechanical Engineering.
3. In addition to fulfilling all the requisites of a Regular B.Tech Programme, a student shall earn 20 additional credits to be eligible for the award of B. Tech (Honors) degree. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e. 160 credits).
4. 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 two MOOCs, which shall be domain specific, each with 2 credits and with a minimum duration of 8/12weeks as recommended by the Board of studies.
5. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course. The courses offered in each pool shall be domain specific courses and advanced courses.
6. The concerned BOS shall decide on the minimum enrolments for offering Honors program by the department. If minimum enrolments criteria are not met then the students shall be permitted to register for the equivalent MOOC courses as approved by the concerned Head of the department in consultation with BOS.
7. Each pool can have theory as well as laboratory courses. If a course comes with a lab component, that component has to be cleared separately. The concerned BOS shall explore the possibility of introducing virtual labs for such courses with lab component.
8. MOOC courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Students have to acquire a certificate from the agencies approved by the BOS with grading or marks or pass/fail in order to earn 4 credits. If the MOOC course is a pass/fail course without any grades, the grade to be assigned will be as decided by the Institute/academic council.
9. The concerned BOS shall also consider courses listed under professional electives of the respective B. Tech programs for the requirements of B. Tech (Honors). However, a

student shall be permitted to choose only those courses that he/she has not studied in any form during the Programme.

10. If a student drops or is terminated from the Honors program, the additional credits so far earned cannot be converted into free or core electives; they will remain extra. These additional courses will find mention in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a “pass (P)” grade and also choose to omit the mention of the course as for the following: The courses which were not done under the dropped Honors will not be shown in the transcript.
11. In case a student fails to meet the CGPA requirement for Degree with Honors at any point after registration, he/she will be dropped from the list of students eligible for Degree with Honors and they will receive regular B.Tech degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.
12. Honors must be completed simultaneously with a major degree program. A student cannot earn Honors after he/she has already earned bachelor’s degree.

7.4 Minor Programme:

In order to obtain Minor degree students shall earn additional 20 credits in addition to the 160 credits for obtaining the UG degree. Students can register for additional courses by satisfying the pre-requisite course(s) to a maximum of 8 credits in each of the semesters from IV semester onwards along with the regular semester courses as prescribed. There is no minimum limit to the credits for taking additional courses.

A student shall be permitted to register for Minors program at the beginning of 4th semester subject to a maximum of two additional courses per semester, provided that the student must have acquired 7.75 CGPA (Cumulative Grade point average) up to the end of 2nd semester without any history of backlogs. It is expected that the 3rd semester results may be announced after the commencement of the 4th semester. If a student fails to acquire 7.75 CGPA up to 3rd semester or failed in any of the courses, his registration for Minors program shall stand cancelled.

- An SGPA and CGPA of 7.75 and above has to be maintained in the subsequent semesters in major degree without any backlogs in order to keep the minor registration active.
- Should both the SGPA and CGPA fall below 7.75 in major degree at any point after registering for the minor; the minor registration will cease to be active.

1. a) Students who are desirous of pursuing their special interest areas other than the chosen discipline of Engineering may opt for additional courses in minor specialization groups offered by a department other than their parent department. For example, If Mechanical Engineering student selects subjects from Civil Engineering under this scheme, he/she will get Major degree of Mechanical Engineering with minor degree of Civil Engineering

   b) Student can also opt for Industry relevant tracks of any branch to obtain the Minor Degree, for example, a B.Tech Mechanical student can opt for the industry relevant tracks like Data Mining track, IOT track, Machine learning track etc.

2. The BOS concerned shall identify as many tracks as possible in the areas of emerging technologies and industrial relevance / demand. For example, the minor tracks can be the fundamental courses in CE, EEE, ME, ECE, CSE, AND IT etc., or industry tracks such as Artificial Intelligence (AI), Machine Learning (ML), Data Science (DS), Robotics, Electric vehicles, VLSI etc.

3. The list of disciplines / branches eligible to opt for a particular industry relevant minor specialization shall be clearly mentioned by the respective BOS.

4. There shall be no limit on the number of programs offered under Minor. The Institution can offer minor programs in emerging technologies based on expertise in the respective departments or can explore the possibility of collaborating with the relevant industries/agencies in offering the program.

5. Out of the 20 Credits, 16 credits shall be earned by undergoing specified courses listed by the concerned BOS along with prerequisites. It is the responsibility of the student to acquire / complete prerequisite before taking the respective course. If a course comes with a lab component, that component has to be cleared separately. A student shall be permitted to choose only those courses that he / she has not studied in any form during the Programme.

6. The concerned BOS shall decide on the minimum enrolments for offering Minor program by the department. If a minimum enrolments criterion is not met, then the students may be permitted to register for the equivalent MOOC courses as approved by the concerned Head of the department in consultation with BOS.

7. A student shall earn additional 20 credits in the specified area to be eligible for the award of B. Tech degree with Minor. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e. 160credits).

8. In addition to the 16 credits, students must pursue at least 2 courses through MOOCs. The courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Student has to acquire a certificate from the agencies approved by the BOS with grading or marks or pass/fail in order to earn 4credits.If the MOOC course is a pass/fail course without any grades, the grade to be assigned as decided by the Institute/academic council.

9. Student can opt for the Industry relevant minor specialization as approved by the concerned departmental BOS. Student can opt the courses from Skill Development Corporation (APSSDC) or can opt the courses from an external agency recommended and approved by concerned BOS and should produce course completion certificate. The Board of studies of the concerned discipline of Engineering shall review such courses being offered by eligible external agencies and prepare a fresh list every year incorporating latest skills based on industrial demand.

10. A committee should be formed at the level of College / Universities / department to evaluate the grades / marks given by external agencies to a student which are approved by concerned BOS. Upon completion of courses the departmental committee should convert the obtained grades / marks to the

maximum marks assigned to that course. The controller of examinations can take a decision on such conversions and may give appropriate grades.

11. If a student drops (or terminated) from the Minor program, they cannot convert the earned credits into free or core electives; they will remain extra. These additional courses will find mention in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a "pass(P)" grade and also choose to omit the mention of the course as for the following: The courses which were not done under the dropped Minors will not be shown in the transcript.

12. In case a student fails to meet the CGPA requirement for B.Tech degree with Minor at any point after registration, he/she will be dropped from the list of students eligible for degree with Minors and they will receive B.Tech degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.

13. Minor must be completed simultaneously with a major degree program. A student cannot earn the Minor after he / she has already earned bachelor's degree.

7.6 Industrial Collaboration (Case Study)

Institute - Industry linkages refer to the interaction between firms and universities or public research centers with the goal of solving technical problems, working on R&D, innovation projects and gathering scientific as well as technological knowledge. It involves the collaboration of Industries and Institutes in various areas that would foster the research ecosystem in the country and enhance growth of economy, industry and society at large.

The Institution is permitted to design any number of Industry oriented minor tracks as the respective BoS feels necessary. In this process the Institution can plan to have industrial collaborations in designing the minor tracks and to develop the content and certificate programs. Industry giants such as IBM, TCS, WIPRO etc., may be contacted to develop such collaborations. The Universities / Institutions shall also explore the possibilities of collaborations with major Industries in the core sectors and professional bodies to create specialized domain skills.

7.7 Mandatory Internships

1. Two summer internships each with a minimum of six weeks duration, done at the end of second and third years, respectively are mandatory. The internship can be done by the students at local industries, Govt. Organizations, construction agencies, Industries, Hydel and thermal power projects and also in software MNCs.

2. A supervisor/mentor/advisor has to be allotted to guide the students for taking up the summer internship. The supervisor shall monitor the attendance of the students while taking up the internship. Attendance requirements are as per the norms of the Institute.

3. Evaluation of the summer internships shall be 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 departmental committee consisting of an external examiner; Head of the Department; supervisor of the internship and a senior faculty member of the department. The report and the oral

presentation shall carry 40% and 60% weightages respectively.

4. It shall be evaluated for 50 external marks at the end of the semester. There shall be no internal marks for Summer Internship.

5. In the final semester, the student should mandatorily undergo internship and in parallel he/she should work on a project with well-defined objectives. At the end of the semester the candidate shall submit an internship completion certificate and a project report. A student shall also be permitted to submit project report on the work carried out during the internship. The project report shall be evaluated with an external examiner.

6. The College shall facilitate and monitor the student internship programs. Completion of internships is mandatory, if any student fails to complete internship, he/she will not be eligible for the award of degree. In such cases, the student shall repeat and complete the internship.

7.8 Skill Oriented Courses

1. For skill oriented / skill advanced course, one theory and 2 practical hours or two theory hours may be allotted as per the decision of concerned BOS.

2. Out of the five skill courses two shall be skill-oriented courses from the same domain and shall be completed in second year. Of the remaining 3 skill courses, one shall be necessarily be a soft skill course and the remaining 2 shall be skill-advanced courses either from the same domain or Job oriented skill courses, which can be of inter disciplinary nature.

3. A pool of interdisciplinary skill oriented courses shall be designed by a common Board of studies by the participating departments / disciplines and the syllabus along with the pre requisites shall be prepared for each of the laboratory infrastructure requirements. The list of such courses shall be included in the curriculum structure of each branch of Engineering, so as to enable the student to choose from the list.

4. The student shall be given an option to choose either the skill courses being offered by the college or to choose a certificate course being offered by industries / Professional bodies / APSSDC, COURSERA or any other accredited bodies as approved by the concerned BOS.

5. The Board of studies of the concerned discipline of Engineering shall review the skill advanced courses being offered by eligible external agencies and prepare a fresh list every year incorporating latest courses based on industrial demand.

6. If a student chooses to take a Certificate Course offered by industries/Professional bodies/APSSDC or any other accredited bodies, in lieu of the skill advanced course offered by the Department, the credits shall be awarded to the student upon producing the Course Completion Certificate from the agency / professional bodies as approved by the Board of studies.

7. If a student prefers to take a certificate course offered by external agency, the department shall mark attendance of the student for the remaining courses in that semester excluding the skill course in all the calculations of mandatory attendance

requirements upon producing a valid certificate as approved by the concerned Board of Studies, the student is deemed to have fulfilled the attendance requirement of the course and acquire the credits assigned to the course.

8. A committee shall be formed at the level of the college to evaluate the grades / marks given for a course by external agencies and convert to the equivalent marks / grades. The recommended conversions and appropriate grades / marks are to be approved by the Institute / Academic Council.

9. The course will be evaluated at the end of the semester for 50 marks (record: 15 marks and viva-voce: 35 marks) along with laboratory end examinations in the presence of external and internal examiner (course instructor or mentor). There are no internal marks for the skill oriented courses.

7.9 Course Numbering Scheme

The Course code consists of Eight / Nine characters. The following is the structure of the course Code (Figure 1).

Course Numbering Scheme (PVP20)

<table>
<tr><td>2</td><td>0</td><td>C</td><td>S</td><td>3</td><td>2</td><td>0</td><td>1</td><td>A</td></tr>
<tr><td colspan="2">Regulation</td><td colspan="2">Course Category</td><td>Kind of course</td><td>Semeste r</td><td>Type</td><td>Course Number</td><td>[Elective code]</td></tr>
<tr><td colspan="2" rowspan="8">Last two digits of Regulation offered(i.e. 20 for PVP20 regulations)</td><td colspan="2">HS-Humanities and Social Sciences including Management courses
BS-Basic Science courses
ES-Engineering Science
MC- Mandatory Courses</td><td>1. Institutional Core(i.e. HS,BS,ES,MC)</td><td rowspan="8">1-First
2-Second
3-Third
4-Fourth
5- Fifth
6-Sixth
7-Seventh
8-Eigth</td><td rowspan="6">0-Theory
1-Theory studied in MOOCS Mode
2-Integrated Course (Theory+Lab)
4- NCC/NSS
5- Practical
6-Project Work
7-Seminar</td><td rowspan="8">i.e. Course sequence Number in that semester</td><td rowspan="6">In case if the course is Elective then this field will specify the elective code (i.e A,B,C...)</td></tr>
<tr><td colspan="2">Respective Handling department code is placed</td><td>2. Open Elective/ Job Oriented Elective</td></tr>
<tr><td colspan="2">In case of Professional Core/ Professional Elective courses department code is placed:
CE-Civil Engineering
EE- Electrical & Electronics Engineering
ME- Mechanical Engineering
EC- Electronics and Communication Engineering
CS- Computer Science & Engineering
IT- Information Technology
AM-CSE(Artificial Intelligence & Machine Learning)
DS-CSE(Data Science)</td><td>3. Professional Core
4. Professional Elective</td></tr>
<tr><td colspan="2">Respective chosen minor department code is placed</td><td>5. Minor Course</td></tr>
<tr><td colspan="2">Respective department code is placed</td><td>6. Honors Course</td></tr>
<tr><td colspan="2">Respective Handling department code is placed</td><td>7. Humanities and Social Science Elective</td></tr>
<tr><td colspan="2" rowspan="2">SO- Skill Oriented Course
SA- Skill Advanced Course
SS- Soft Skill Course</td><td rowspan="2">8. Skill Oriented/ Skill Advanced/ Soft Skill Course</td><td>8. Summer/ Industrial/ Research Internship</td><td>A - Summer
B – Industrial
C - Research</td></tr>
<tr><td>9. Community Service Project</td><td></td></tr>
</table>

Figure 1: Course numbering scheme

7.10 Medium of Instruction and Examination

The medium of instruction and examinations shall be English.

7.11 Registration

Every student has to register himself/herself for the courses in each semester individually at the time as specified in academic calendar.

8. Choice Based Credit System (CBCS)

Choice Based Credit System (CBCS) shall be introduced with effect from 2019-20 academic years, based on guidelines of the statutory bodies in order to promote:

- Activity based learning
- Student centered learning
- Students to choose courses of their choice
- Learning at their own pace

Flexibility is extended to the fast learning students to take the courses of higher semesters in advance as per their convenience to concentrate on their placement activity/ project work, etc., during the VII/VIII semesters.

8.1 CBCS Course Registration Policy

Fast learning students can register for additional courses from higher semesters by satisfying the pre-requisite course(s) to a maximum of 8 credits in each of the semesters from III semester onwards along with the regular semester courses as prescribed. There is no minimum limit to the credits for taking additional courses.

Eligibility for choosing CBCS flexibility:

- **Regular Students (4 Year duration),** entering the n^{th} semester with no backlog courses up to $(n-1)^{th}$ semester, are only eligible to opt for this flexibility.
- **Lateral entry students (3 year duration)** with 70% Marks in their Diploma are eligible to opt for this flexibility during III and IV Semesters. Those students entering into V/ VI /VII semester with no backlog courses up to $(n-1)^{th}$ semester, are only eligible to opt for this flexibility.

The list of additional courses offered in the even & odd semesters, registration dates will be notified by the respective departments well in advance.

A student can withdraw from the respective course within 15 days after the commencement of the course.

The choice of utilizing this flexibility is purely optional to the students.

A minimum number of students required to register for an additional course shall be twenty (20). In case, the registered strength for the additional course is less than twenty (20), the course may be offered on the recommendation of the Head of the Department and subsequent approval of the Principal.

8.2 Continuous Internal Evaluation (CIE) for CBCS opted Courses

The contact hours, continuous assessment pattern, eligibility criteria to write end semester examinations and revaluation scheme for these additional courses will be as per the current academic regulations [PVP20].

8.3 Eligibility to appear CBCS registered courses for Semester End Examinations

The registered additional courses will be dealt separately as individual courses for the calculation of attendance and continuous assessment of marks for assessing the eligibility to write the end semester examinations for these courses.

The performance of the student in the registered additional courses will be separately mentioned in the semester end grade card and it will not be taken into account for the calculation of the SGPA for that semester.

The performance of the student in the registered additional courses will be taken into account in the corresponding semesters.

8.4 CBCS Course Detention

8.4.1 In case, the student is detained for want of minimum specified attendance and continuous assessment marks criterion either in the regular semester or in the additional courses, he/she will forfeit the eligibility for registering additional courses from that semester onwards. However, the additional courses completed by the students in the earlier semesters will be valid and taken into consideration.

8.4.2 In case, the student is detained for want of minimum specified attendance and continuous assessment marks criterion in the regular semester but meets minimum specified attendance and continuous assessment marks criterion in the registered additional courses, he/she shall write the end semester examinations for these additional courses along with the regular students in the corresponding semester only.

8.4.3 In case, the student fails / is absent in the end semester examinations of the registered additional courses or in the regular semester courses in a particular semester, he will forfeit the eligibility for registering additional courses from that semester onwards. However, the additional courses completed by the students in the earlier semesters will be valid and taken into consideration. They can write the end semester examinations for additional courses in which they failed/were absent, along with regular students in the corresponding semesters only.

8.4.4 The criterion for the promotion to higher semesters will be as per PVP20 regulations, taking only the regular semester courses into consideration for the fast learners.

8.4.5 Additional courses, in which the fast learning student fails, will not be considered as backlogs for them.

8.4.6 The fast learning students shall register for all the courses of a regular semester excluding the courses completed in the previous semesters.

8.4.7 The credits scored by students through CBCS subjects shall not be considered for credit promotion from II year to III year or from III year to IV year B.Tech.

8.4.8 The student opting for the said flexibility will be considered for the award of the division on par with other regular students.

8.4.9 The students who have earlier history of indulging in malpractices in semester end examinations are not eligible for opting CBCS.

8.4.10 If the student fails to register for opted CBCS courses for semester end examination, he/she will forfeit the eligibility for registering additional courses from that semester onwards and marks secured through continuous assessment will not be considered.

8.4.11 The choice of utilizing this flexibility is purely optional to the students.

8.4.12 If a student fails/absent in a CBCS course, he/she is bound to appear in the same course when studied in regular semester.

9 EXAMINATIONS & SCHEME OF EVALUATION

9.1 Description of Evaluation

1. **Continuous Internal Evaluation (CIE):** The performance of the student in each course is evaluated by the faculty/course coordinator all through the semester; with mid-term tests (sessional-1and sessional-2), assignments, project reviews, viva-voce, laboratory assessment and other means covering the entire syllabus of the course.

2. **Semester End Examination (SEE):** It shall be conducted by chief controller of examinations at the end of each semester, as per the academic calendar and with a written examination for theory courses and practical/project examination with built-in oral part for laboratory/project.

9.2 Continuous Internal Evaluation (CIE)

9.2.1 Theory Courses

a) For theory subjects, during a semester, there shall be two mid-term examinations. Each mid-term examination consists of (i) one objective examination (20 multiple choice questions) for 10 marks for duration of 20 minutes (ii) one descriptive examination (3 full questions for 5 marks each) for 15 marks for duration of 90 minutes and (iii) one assignment for 5 marks. Mid-1 shall be conducted from first 50% of the syllabi.

b) In the similar lines, the second objective, descriptive examinations, assignment shall be conducted on the rest of the 50% syllabus.

c) The total marks secured by the student in each mid-term examination are evaluated for 30 marks. The first mid marks (Mid-1) consisting of marks of objective examination, descriptive examination and assignment shall be submitted by the concerned teacher to the department examination section within one week after completion of first mid examination.

d) The mid marks submitted to the department examination section shall be displayed in the concerned department notice boards for the benefit of the students.

e) If any discrepancy found in the submitted Mid-1 marks, it shall be brought to the notice of Head of the department within one week from the submission.

f) Second mid marks (Mid-2) consisting of marks of objective examination, descriptive Examination and assignment shall also be submitted by the concerned teacher to the department examination section within one week after completion of second mid examination and it shall be displayed in the notice boards. If any discrepancy found in the submitted mid-2 marks, it shall be brought to the notice of Head of the department within one week from the submission.

g) Internal marks can be calculated with 80% weightage for better of the two mids and 20% Weightage for other mid exam.

Example:

Mid-1 marks = Marks secured in (Objective-1+Descriptive examination-1 +Assignment-1)

Mid-2 marks = Marks secured in (Objective-2+Descriptive examination-2 +Assignment-2)

Final internal Marks = (Best of (Mid-1/Mid-2) marks x 0.8

+ Least of (Mid-1/Mid-2) marks x 0.2)

h) With the above criteria, concerned departments have to display the consolidated marks obtained by the students in the department notice boards. If any discrepancy found, it shall be brought to the notice of Head of the department through proper channel within one week with all proofs.

9.2.2 Mandatory Learning Courses

Mandatory Course (M.C): Environmental Sciences, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge, Life Sciences for Engineers, etc. non-credit (zero credits) mandatory courses. Environmental Sciences shall be offered compulsorily as mandatory course for all branches. A minimum of 75% attendance is mandatory in these subjects. There shall be an external examination for 70 marks and it shall be conducted by the college internally. Two internal examinations shall be conducted for 30 marks and a student has to secure at least 40% of the marks for passing the course. No marks or letter grade shall be printed in the transcripts for all mandatory non-credit courses, but only Completed (Y)/Not-completed (N) will be specified.

9.2.3 Drawing Based Courses:

For the subject having design and / or drawing, (such as Engineering Graphics, Engineering Drawing, Machine Drawing) and estimation, the distribution shall be 30 marks for internal evaluation (15 marks for continuous Assessment (day–to–day work) and 15 marks for internal tests) and 70 marks for end examination. There shall be two internal tests in a Semester for 15 marks each and final marks can be calculated with 80% weightage for better of the two tests and 20% weightage for other test and these are to be added to the marks obtained in day to day work.

9.2.4 Laboratory Courses

For practical subjects there shall be continuous evaluation during the semester for 15 internal marks and 35 end examination marks. The internal 15 marks shall be awarded as follows: day today work - 5 marks, Record-5 marks and the remaining 5 marks to be awarded by conducting an internal laboratory test. The end examination shall be conducted by the teacher concerned and external examiner appointed.

Table: Distribution of Marks (CIE)

S. No.	Criterion	Marks
1	Day to Day Evaluation	5
2	Record	5
3	Internal Examination	5

9.2.5 MOOCs Courses

There shall be a Discipline Centric Elective Course through Massive Open Online Course (MOOC) as Program Elective course. The student shall register for the course (Minimum of 12 weeks) offered by SWAYAM/NPTEL through online with the approval of Head of the Department. The Head of the Department shall appoint one mentor for each of the MOOC subjects offered. The student needs to register the course in the SWAYAM/NPTEL portal. During the course, the mentor monitors the student's assignment submissions given by SWAYAM/NPTEL. The student needs to submit all the assignments given and needs to take final exam at the proctor center. The student needs to earn a certificate by passing the exam. The student will be awarded the credits given in curriculum only by submission of the certificate. In case if student does not pass subjects registered through SWAYAM/NPTEL, the same or alternative equivalent subject may be registered again through SWAYAM/NPTEL in the next semester with the recommendation of HOD and shall pass.

9.3 Semester End Examination (SEE)

9.3.1 Theory Courses:

a) The semester end examinations will be for 70 marks consisting of five questions carrying 14 marks each. Each of these questions is from one unit and may contain sub- questions. For each question there will be an "either" "or" choice, which means that there will be two questions from each unit and the student should answer either of the two questions.

b) The job oriented skill courses may be registered at the college or at any accredited external agency. A student shall submit a record/report on the on the list skills learned. If the student completes job oriented skill course at external agency, a certificate from the agency shall be included in the report. The course will be evaluated at the end of the semester for 50 marks (record: 15 marks and viva-voce: 35 marks) along with laboratory end examinations in the presence of external and internal examiner (course instructor or mentor). There are no internal marks for the job oriented skill courses.

9.3.2 Laboratory Courses: 35 marks

i. The Semester end examination for laboratory courses shall be conducted with three hour duration at the end of semester for 35 marks as given below:

Table : Distribution of Marks (SEE)

S.No.	Criterion	Marks
1	Procedure	5
2	Experiment / Programme Execution	15
3	Result	10
4	Viva-Voce	5

ii. Each Semester end Laboratory Examination shall be conducted by an External Examiner along with the Internal Examiner.

9.3.3 Internship: 50 Marks (Only External marks)

Evaluation of the summer internships: It shall be completed in collaboration with local industries, Govt. Organizations, construction agencies, Industries, Hydel and thermal power projects and also in software MNCs in the area of concerned specialization of the UG programme. Students shall pursue this course during summer vacation just before its offering as per course structure. The minimum duration of this course is at least 6 weeks. The student shall register for the course as per course structure after commencement of academic year. A supervisor / mentor / advisor have to be allotted to guide the students for taking up the summer internship. The supervisor shall monitor the attendance of the students while taking up the internship. Attendance requirements are as per the norms of the Institute. After successful completion, students shall submit a summer internship technical report to the concerned department and appear for an oral presentation before the departmental committee consists of an external examiner; Head of the Department; supervisor of the internship and a senior faculty member of the department. A certificate from industry / skill development center shall be included in the report. The report and the oral presentation shall carry 40% and 60% weightages respectively. It shall be evaluated for 50 external marks at the end of the semester. There shall be no internal marks for Summer Internship. A student shall secure minimum 40% of marks for successful completion. In case, if a student fails, he/she shall reappear as and when semester supplementary examinations are conducted by the Institute.

9.3.4 Community Service Project (CSP): 100 Marks

Report on CSP should be submitted by each student. An internal Viva shall also be conducted by a Committee constituted by the Principal of the college. The assessment is to be conducted for **100 marks**. The number of credits assigned is 4. Later the marks are converted into grades and grade points to include finally in the SGPA and CGPA. A student shall secure minimum 40% of marks for successful completion. In case, if a student fails, he/she shall reappear as and when semester supplementary examinations are conducted by the Institute. The students must do the community service project in the vacation period after I-II .

The weightings shall be:

Activity Log 20% CSP Implementation 30%

Report 25% Presentation 25%

For Complete details: https://www.jntuk.edu.in/jntuk-dap-community-service-project-guidelines-reg/

9.3.5 Major Project

(Project - Project work, seminar and internship in industry):

In the final semester, the student should mandatorily register and undergo internship and in parallel he/she should work on a project with well-defined objectives. At the end of the semester the candidate shall submit an internship completion certificate and a project report. A student shall also be permitted to submit project report on the work carried out during the internship. The project report shall be evaluated with an external examiner.

Evaluation: The total marks for project work for **200 marks** and distribution shall be **60 marks for internal** and **140 marks** for **external** evaluation. The supervisor assesses the student for 30 marks (Report: 15 marks, Seminar: 15 marks). At the end of the semester, all projects shall be showcased at the department for the benefit of all students and staff and the same is to be evaluated by the departmental Project Review Committee consisting of supervisor, a senior faculty and HOD for 30 marks. The external evaluation of Project Work is a Viva-Voce Examination conducted in the presence of internal examiner and external examiner and is evaluated for 140 marks.

9.4 Conditions for Pass Marks

I. Paper setting and evaluation of the answer scripts shall be done as per the procedures laid down by the Institution Examination section from time to time.

II. To maintain the quality, external examiners and question paper setters shall be selected from premier institutes and Universities, NITs, Autonomous colleges.

III. For non-credit mandatory courses, like Life sciences for Engineers, Environmental Sciences, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge, the student has to secure 40% of the marks allotted in the internal evaluation for passing the course. No marks or letter grade shall be allotted for all mandatory non-credit courses.

IV. A student is deemed to have satisfied the minimum academic requirements if he has earned the credits allotted to each theory/practical design/drawing subject/ project etc by securing not less than 35% of marks in the end semester exam and minimum 40% of marks in the sum total of the internal marks and end semester examination marks together.

V. **Distribution and Weightage of marks**:
The assessment of the student's performance in each course will be as per the details given

SNo	Component	Internal	External	Total
1	Theory	30	70	100
2	Lab	15	35	50
3	Mandatory	30	70	100
4	Drawing	30	70	100
5	Project	60	140	200
6	Mini Project/Internship/Industrial Training / Skill Development Programs/Research Project	-	50	50

9.5 Revaluation

9.5.1 Continuous Internal Evaluation

The continuous Evaluation scripts shall be shown to the students before finalizing the marks. However, if the student has any concern, not addressed before the finalization of marks, he/she may submit the application for revaluation to the concerned head of the department. The Head of the Department may constitute a two-member committee for re-evaluating the script. The evaluation of the committee is final and binding.

9.5.2 Semester End Examination

1. As per the notification issued by the Controller of Examinations, the students can submit the applications for revaluation, along with the requisite fee receipt for revaluation of his/her answer script(s) of theory course(s), if he/she is not satisfied with the marks obtained.
2. The Controller of Examinations shall arrange for re-evaluation of those answer script(s).
3. A new external examiner, other than the first examiner, shall re-evaluate the answer script(s).
4. Revaluation marks will be taken into consideration only if the difference between the two valuations is more than or equal to 15%. Better marks between the two shall be taken into consideration. However, if the revaluation marks facilitates passing of the candidate, then the revaluation marks will be considered even if the difference of marks is less than 15%.
5. If the difference of marks between the two valuations is more than 20%, the answer script will be referred to third valuation. The average of nearest two marks will be awarded.

9.6 Withholding of Results

If the student has not paid the dues to the college, or if any case of malpractice or indiscipline is pending against him, the result of the student will be kept as withheld and he/she will not be allowed to enter the next semester. His/her degree shall be considered as withheld in such cases.

10 CRITERIA TO ATTEND SEMESTER END EXAMINATION AND PROMOTION TO HIGHER SEMESTER

10.1 Eligibility for Semester End Examinations

10.1.1 Students shall put in a minimum average attendance of 75% in the courses. computed by totalling the number of periods of lectures, tutorials, drawing, practical and project work as the case may be, held in every course as the denominator and the total number of periods attended by the student in all the courses put together as the numerator, to be eligible to write semester end examinations.

10.1.2 Condonation of shortage in attendance may be recommended by respective Heads of Departments on genuine medical grounds, provided the student puts in at least 65% attendance as calculated above and provided the Principal is satisfied with the genuineness of the reasons and the conduct of the student.

10.1.3 Students, having more than 65% and less than 75% of attendance, shall have to pay requisite fee towards condonation.

10.2 Promotion Rules

1. A student shall be promoted from first year to second year if he fulfills the minimum attendance requirements.
2. A student will be promoted from II year to III year if he fulfills the academic requirement of 40% of credits up to either II year I-Semester or II year II-Semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in II year II semester.
3. A student shall be promoted from III year to IV year if he fulfills the academic requirements of 40% of the credits up to either III year I semester or III year II semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in III year II semester.

11. SUPPLEMENTARY EXAMINATIONS

1. **General**

Semester end Supplementary examinations shall be conducted along with regular semester end examinations.

2 **Advanced Supplementary Exams**

Candidate(s), who fails in Theory or Laboratory courses of VIII semester, can appear for advanced supplementary examination conducted within one month after declaration of the revaluation results. However, those candidates who fail in the advanced supplementary examinations of VIII semester shall appear for subsequent examinations along with regular candidates conducted at the end of the respective academic year.

12. READMISSION CRITERIA

A candidate, who is detained in a semester due to lack of attendance/credits, has to obtain written permission from the Principal for readmission into the same semester after duly fulfilling all the required norms stipulated by the college in addition to paying an administrative fee of **Rs. 1,000/-**

Rules for calculation of attendance for readmitted students

a) Number of classes conducted shall be counted from the commencement day of the semester concerned, irrespective of the date of payment of tuition fee.

b) They shall submit a written request to the principal of the college, along with a challan paid towards tuition and other fee, for readmission before the commencement of the class work.

c) They can get the information regarding date of commencement of class work for each semester that will be made available in the college notice boards/website from time to time.

13 BREAK IN STUDY

Student, who discontinues the studies for valid reason permitted by the principal, shall get readmission into appropriate semester of B.Tech. programme after break-in study, with the prior permission of the Principal and following the transitory regulations applicable to such batch in which he/she joins. An administrative fee of **Rs**. 1**000/-**per each year of break in study, in addition to the prescribed tuition and special fee has to be paid by the candidate to condone his/her break in study.

14 GAP YEAR

Gap Year – concept of Student Entrepreneur in Residence shall be introduced and outstanding students who wish to pursue entrepreneurship are allowed to take a break of one year at any time after I year/II year/III year to pursue entrepreneurship full time. This period shall be counted for the maximum time for graduation. An evaluation committee at Institution level shall be constituted to evaluate the proposal submitted by the student and the committee shall decide on permitting the student for availing the Gap Year.

15 TRANSITORY REGULATIONS

A candidate, who is detained or discontinued in a semester, on re-admission, the academic regulations under which he/she has originally admitted will continue to be applicable to him/her on re-admission.

16 ELIGIBILITY FOR AWARD OF B.TECH DEGREE

1. The B.Tech. Degree shall be conferred on a candidate who satisfies the following requirements.

   a) A Regular student (four year programme) shall register and secure himself/herself for **160** Credits

   b) A Lateral Entry student (three year programme) shall register and secure himself/herself for**12**1 credits

2. **Award of Division**

   The criteria for award of division, after successful completion of programme are as shown in Table:

Table : Criteria for Award of Division

Class Awarded	CGPA to be secured	Remarks
First class with distinction	≥7.75 (Without any supplementary appearance)	From the CGPA secured from 160 credits
First class	≥6.75	
Second class	≥5.75 to <6.75	
Pass Class	≥5.00 to <5.75	

- Awarded only if all the courses prescribed are cleared in single attempt within four years for regular candidates and three years for lateral entry candidates
- Detained and break-in study candidates are not eligible for the award of First Class with Distinction
- The cases of students who are absent for semester end examination only once in his/her duration of B.Tech. Programme on valid medical grounds/humanitarian grounds shall also be considered for the award of First class with Distinction subject to the recommendations of the committee constituted by the Principal.

For the purpose of awarding First, Second and Pass Class CGPA obtained in the examinations appeared within the maximum period allowed for the completion of the programme shall be considered.

Consolidated Grade Card

A consolidated grade card containing credits & grades obtained by the students will be issued after successful completion of the four year B.Tech Programme.

17 CONDUCT AND DISCIPLINE

1. Students shall conduct themselves within and outside the premises of the Institute in a manner befitting the students of our Institution.
2. As per the order of Honorable Supreme Court of India and AICTE guidelines, ragging in any form is considered a criminal offence and is banned. Ragging within or outside any educational institution is prohibited. Ragging means doing an act, that causes or is likely to cause insult or annoyance or fear of apprehension or threat or intimidation or outrage of modesty or injury to a student. Any form of ragging will be severely dealt with as per AP Prohibition of Ragging Act-1997 section-4.

Table : Punishments for Ragging

Nature of ragging	Punishment
Teasing, embarrassing and humiliating	Imprisonment up to 6 months or fine up to Rs.1,000/- or both
Assaulting or using criminal force or criminal intimidation	Imprisonment up to 1 year or fine up to Rs.2,000/- or both
Wrongfully restraining or confining or causing hurt	Imprisonment up to 2 years or fine up to Rs.5,000/- or both
Causing grievous hurt kidnapping or raping or committing unnatural offence	Imprisonment up to 5 years and fine up to Rs.10,000/-
Causing death or abetting suicide	Imprisonment up to 10 years and fine up to Rs.50,000/-

3. A student who is convicted of an offence and punished with imprisonment for a term of more than six months shall not be admitted into the institution.
4. Whenever any student complains of ragging to the head or manager of an educational institution, such head or manager should inquire into the complaint and if the complaint is prima-facie found true, should suspend the student or students complained against.
5. If the head or manager of an educational institution fails or neglects to take action in the manner specified in the Act, the person shall be deemed to have abetted the offence and shall be punished with the punishment provided for the offence.
6. If a student commits suicide due to or in consequence of ragging, the person who commits such ragging shall be deemed to have abetted such suicide.
7. The following acts of omission and/or commission shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measures.

i. Lack of courtesy and decorum; indecent behaviour anywhere within or outside the campus

ii. Possession, consumption or distribution of alcoholic drinks or any kind of narcotics or hallucinogenic drugs.

The following activities are not allowed within the campus:

- Mutilation or unauthorized possession of library books.
- Noisy and unseemly behaviour, disturbing studies of fellow students.
- Hacking computer systems (such as entering into other person's areas without prior permission, manipulation and/or damage of computer hardware and software or any other cybercrime etc.)
- Use of mobile phones.
- Plagiarism of any nature.
- Any other act of gross indiscipline as decided by the Institute from time to time.
- Commensurate with the gravity of offense, the punishment may be reprimand, fine, expulsion from the institute/ hostel, debarment from a examination, disallowing the use of certain facilities of the Institute, rustication for a specified period or even outright expulsion from the Institute, or even handing over the case to appropriate law enforcement authorities or the judiciary, as required by the circumstances.
- For an offence committed in (i) a hostel, (ii) a department or in a class room and (iii) elsewhere, the Chief Warden, the Head of the Department and the Principal, respectively, shall have the authority to reprimand or impose fine.
- Cases of adoption of unfair means and/or any malpractice in an examination shall be reported to the Principal for taking appropriate action.
- Unauthorized collection of money in any form is strictly prohibited.
- Detained and break-in-study candidates are allowed into the campus for academic purposes only with the permission from authorities.
- Misconduct committed by a student outside the Institute campus but having the effect of damaging, undermining & tarnishing the image & reputation of the institution will make the student concerned liable for disciplinary action commensurate with the nature and gravity of such misconduct.
- The disciplinary action committee constituted by the Principal, shall be the authority to investigate the details of the offence, and recommend disciplinary action based on the nature and extent of the offence committed.
- Grievance redressal committee, constituted by the Principal, shall deal with all grievances pertaining to the academic/ administrative and disciplinary matters.
- All the students must abide by the code and conduct rules of the Institute.

18 MALPRACTICES

The Principal shall refer the cases of malpractices by students in internal assessment tests and end semester examinations, to a malpractice enquiry committee constituted for the purpose. The committee shall follow the approved scales of punishment.

The committee consists of:

1. Heads of Department (Three)
2. Controller of Examinations
3. Assistant Controller of Examinations

Table – 10: Disciplinary action for malpractices/improper conduct in examinations

	Nature of Malpractices/Improper conduct	**Punishment**
1 (a)	If the candidate possesses or keeps accessible, any paper, note book, programmable calculators, mobile phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in the examination hall but has not made use of (material shall include any marks on the student's body that can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	If the candidate gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through mobile phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2	If the candidate has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work. He shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The hall ticket of the candidate is to be cancelled.
3	If the candidate impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate, who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4	If the candidate smuggles in an answer book or additional sheet or takes out	Expulsion from the examination hall and cancellation of performance in that subject and

	or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all other examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5	If the candidate uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6	If the candidate refuses to obey the orders of the Chief Superintendent/Assistant - Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which results in damage to or destruction of property in the examination hall or any part of the Institute campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the Institute, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7	If the candidate leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work

		and all other examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8	If the candidate possesses any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9	If student of the Institute, who is not a candidate for the particular examination or any person not connected with the Institute indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the Institute: Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work. He shall not be permitted for the remaining examinations of the subjects of that semester/ year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the Institute: Will be handed over to police and a police case will be registered against them.
10	If the candidate comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work. He shall not be permitted for the remaining examinations of the subjects of that semester/year.
11	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12	If any malpractice is detected which is not covered in the above clauses 1 to 11, shall be awarded suitable punishment.	

Note: Special squads may be formed to oversee the proper conduct of examinations.

19 OTHER MATTER

19.1 Scribe facility is extended to B Tech students strictly following the guidelines issued under F. No. 16-110/2003-DD.III Dt. 26-02-2013 by the Ministry of Social Justice and Empowerment, Department of Disability Affairs, Govt. of India.

19.2 Students who are suffering from contagious diseases are not allowed to appear either continuous internal assessment or semester end examinations

19.3 The students who participate in coaching/tournaments held at State/National/International levels through University/Indian Olympic Association during semester end examination period will be promoted to subsequent semesters till the entire programme is completed as per the guidelines of University Grants Commission Letter No. F.1-5/88 (SPE/PES), dated18-08-1994.

19.4 Based on the recommendations of HOD & Principal, exemption from attending the class work shall be given to those students who secure placement and intend to join as the employer in VIII semester of B.Tech. Special Continuous Internal Evaluation (Assignment Tests, Sessional, etc.,) will be arranged to such candidates separately if necessary. However, they shall appear for Semester End Examinations as per the Academic Calendar

19.5 The Principal shall deal with any academic problem, which is not covered under these rules and regulations, in consultation with the Heads of the Departments in an appropriate manner, and subsequently such actions shall be placed before the academic council for ratification. Any emergency modification of regulation, approved in the Heads of the Departments Meetings, shall be reported to the academic council for ratification.

20 GENERAL

1 Wherever the words “he”, “him”, “his”, occur in the regulations, they may include “she”, “her”, “hers”.
2 The academic regulations should be read as a whole for the purpose of any interpretation.
3 In case of any doubt or ambiguity in the interpretation of above rules, the decision of the principal is final.

21 INSTITUTE RULES AND REGULATIONS

1 Use of **Mobile phones** is strictly prohibited inside the Institute academic area.
2 Students should come to Institute in **proper dress**.
3 All students should wear **Identity cards** in the Institute premises.
4 Students should be present in their respective classrooms **before the commencement of class sharply**.
5 Students should not leave the Institute premises without prior permission of their respective Heads of the departments during Institute working hours.
6 Students should maintain silence in the class rooms during working periods.
7 Sitting / wandering of the students at the stair cases, corridors, cycle stands or the areas within the Institute premises is strictly prohibited.
8 Usage of Vehicle horn inside the Institute premises is prohibited.

22 AMENDMENTS TO REGULATIONS

The Academic Council may, from time to time, revise, amend or change the regulations, schemes of examination and/or syllabi.

Oratory

PRINCIPAL

B.Tech

CSE

COURSE STRUCTURE

PVP SIDDHARTHA INSTITUTE OF TEHNOLOGY, KANURU, VIJAYAWADA
(AUTONOMOUS)

COMPUTER SCIENCE AND ENGINEERING

I B.Tech.- I Semester

Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
20HS1101	Communicative English I	3	3	0	0	30	70	100
20BS1101	Calculus and Linear Algebra	3	3	0	0	30	70	100
20BS1103	Engineering Physics	3	3	0	0	30	70	100
20ES1101	Basic Electrical & Electronics Engineering	3	3	0	0	30	70	100
20ES1103	Problem Solving Techniques	3	3	0	0	30	70	100
20HS1151	Communicative English I Lab	1.5	0	0	3	15	35	50
20BS1152	Engineering Physics Lab	1.5	0	0	3	15	35	50
20ES1151	Basic Electrical & Electronics Engineering Lab	1.5	0	0	3	15	35	50
Total Credits		**19.5**						

L - Lecture T - Tutorial P – Practical

PVP SIDDHARTHA INSTITUTE OF TEHNOLOGY, KANURU, VIJAYAWADA
(AUTONOMOUS)

COMPUTER SCIENCE AND ENGINEERING

I B.Tech.- II Semester

Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
20HS1201	Communicative English II	3	3	0	0	30	70	100
20BS1202	Engineering Chemistry	3	3	0	0	30	70	100
20BS1204	Probability and Statistics	3	3	0	0	30	70	100
20ES1202	Programming for Problem Solving	3	3	0	0	30	70	100
20ES1204	Engineering Graphics	3	1	0	4	30	70	100
20HS1251	Communicative English II Lab	1.5	0	0	3	15	35	50
20BS1251	Engineering Chemistry Lab	1.5	0	0	3	15	35	50
20ES1253	Programming for Problem Solving Lab	1.5	0	0	3	15	35	50
20MC1201	Life Sciences for Engineers	0	2	0	2	30	70	100
Total Credits		**19.5**						

L - Lecture T - Tutorial P – Practical

PVP SIDDHARTHA INSTITUTE OF TEHNOLOGY, KANURU, VIJAYAWADA (AUTONOMOUS)

COMPUTER SCIENCE AND ENGINEERING

II B.Tech – I Semester

Course code	Course title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
20BS1303	Discrete Mathematical Structures	3	3	0	0	30	70	100
20CS3301	Fundamentals of Digital Logic Design	3	3	0	0	30	70	100
20CS3302	Object Oriented Programming through C++	3	3	0	0	30	70	100
20CS3303	Computer Organization and Architecture	3	3	0	0	30	70	100
20ES1305	Data Structures	3	3	0	0	30	70	100
20CS3351	Object Oriented Programming through C++ Lab	1.5	0	0	3	15	35	50
20ES1356	Data Structures Lab	1.5	0	0	3	15	35	50
20CS3352	Python Programming	1.5	0	0	3	15	35	50
20SO8355	Introduction to Linux Operating System	2	1	0	2	0	50	50
20MC1301	Environmental Sciences	0	3	0	0	100	0	100
20MC1341A/ 20MC1341B	NSS / NCC	Completed / Not Completed	0	0	2	0	0	0
20CS3391	Community Service Project	4	0	0	0	0	100	100
	Total Credits	**25.5**						

L - Lecture T - Tutorial P – Practical

PVP SIDDHARTHA INSTITUTE OF TEHNOLOGY, KANURU, VIJAYAWADA (AUTONOMOUS)

COMPUTER SCIENCE AND ENGINEERING

II B.Tech – II Semester

Course code	Course title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
20BS1403	Formal Languages and Automata Theory	3	3	0	0	30	70	100
20CS3401	Operating Systems	3	3	0	0	30	70	100
20CS3402	Advanced Data Structures	3	3	0	0	30	70	100
20CS3403	Design and Analysis of Algorithms	3	3	0	0	30	70	100
20ES1402	Internet of Things	3	3	0	0	30	70	100
20ES1452	Internet of Things Lab	1.5	0	0	3	15	35	50
20CS3451	Advanced Data Structures through C++ Lab	1.5	0	0	3	15	35	50
20CS3452	Design and Analysis of Algorithms Lab	1.5	0	0	3	15	35	50
20SO8454	Programming with JAVA	2	1	0	2	0	50	50
	Total Credits	**21.5**						
Honors in CSE								
20CS6421	Mathematics for Machine Learning	4	4	0	0	30	70	100
	Advanced Python Programming	4	3	0	2	30	70	100
	Advanced Computer Architecture	4	4	0	0	30	70	100

Minor in CSE								
20CS5401	Computational Thinking	4	4	0	0	30	70	100

L - Lecture T - Tutorial P – Practical

PVP SIDDHARTHA INSTITUTE OF TEHNOLOGY, KANURU, VIJAYAWADA
(AUTONOMOUS)

COMPUTER SCIENCE AND ENGINEERING

III B.Tech – I Semester

Course code	Course title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
20CS3501	Software Engineering	3	3	0	0	30	70	100
20CS3502	Database Management Systems	3	3	0	0	30	70	100
20CS3503	Computer Networks	3	3	0	0	30	70	100
Open Elective Course-1/Job oriented elective								
20CE2501A	Air Pollution and Control	3	3	0	0	30	70	100
20EC2501A	Sensor Technology	3	3	0	0	30	70	100
20EC2501B	Electronics Instrumentation	3	3	0	0	30	70	100
20EE2501A	Electrical Safety	3	3	0	0	30	70	100
20ME2501A	Design Thinking	3	3	0	0	30	70	100
20ME2501B	Logistics and Supply Chain Management	3	3	0	0	30	70	100
Professional Elective Course-1								
20CS4501A	Data Science	3	3	0	0	30	70	100
20CS4501B	Cryptography and Information Security							
20CS4501C	Object Oriented Analysis and Design							
20CS4501D	Artificial Intelligence							
20CS3551	Database Management Systems Lab	1.5	0	0	3	15	35	50
20CS3552	Computer Networks Lab	1.5	0	0	3	15	35	50
20SS8551	Soft Skills	2	1	0	2	0	50	50

20MC1501	Constitution of India	0	2	0	0	30	70	100
20CS3581A	Summer Internship 2 Months (Mandatory) after second year(to be evaluated during V semester	1.5	0	0	0	0	50	50
	Total Credits	**21.5**						
Honors in CSE								
20CS6522	Advanced Java Programming	4	3	0	2	30	70	100
	Computer Vision	4	4	0	0	30	70	100
	Time Series Analysis	4	4	0	0	30	70	100
Minor in CSE								
20CS5502	Software Engineering	4	4	0	0	30	70	100

L - Lecture T - Tutorial P – Practical

PVP SIDDHARTHA INSTITUTE OF TEHNOLOGY, KANURU, VIJAYAWADA (AUTONOMOUS)

COMPUTER SCIENCE AND ENGINEERING

III B.Tech – II Semester

Course code	Course title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
20CS3601	Compiler Design	3	3	0	0	30	70	100
20CS3602	Machine Learning	3	3	0	0	30	70	100
20CS3603	MERN Stack Development	3	3	0	0	30	70	100
Open Elective Course-2/Job oriented elective								
20CE2601A	Ecology and Environment	3	3	0	0	30	70	100
20EC2601A	MAT Lab Programming	3	3	0	0	30	70	100
20EC2601B	TV Engineering	3	3	0	0	30	70	100
20EE2601A	Energy Management	3	3	0	0	30	70	100
20ME2601A	Value Engineering	3	3	0	0	30	70	100
20ME2601B	Human Factors in Engineering	3	3	0	0	30	70	100
Professional Elective Course-2								
20CS4601A	Design Patterns	3	3	0	0	30	70	100
20CS4601B	Software Defined Networks							
20CS4601C	Block Chain Technology							
20CS4601D	Computer Graphics							
20CS3651	Compiler Design Lab	1.5	0	0	3	15	35	50
20CS3652	Machine Learning Lab	1.5	0	0	3	15	35	50
20CS3653	MERN Stack Development Lab	1.5	0	0	3	15	35	50
20SA8651	Mobile App Development	2	1	0	2	0	50	50
20MC1602	Universal Human Values	0	2	0	0	30	70	100
	Total Credits	**21.5**						

Honors in CSE								
20CS6621	TCP/IP	4	4	0	0	30	70	100
	Data Visualization	4	3	0	2	30	70	100
	Distributed Databases	4	4	0	0	30	70	100
Honors MOOCs								
-	MOOC course from Swayam NPTEL	2	0	0	2	-	-	-
Minor in CSE								
20CS5621	Web Technologies	4	3	0	2	30	70	100
-	MOOC course from Swayam NPTEL	2	0	0	2	-	-	-

L - Lecture T - Tutorial P – Practical

PVP SIDDHARTHA INSTITUTE OF TEHNOLOGY, KANURU, VIJAYAWADA (AUTONOMOUS)

COMPUTER SCIENCE AND ENGINEERING

IV B.Tech – I Semester

Course code	Course title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
Professional Elective Course-3								
20CS4701A	Deep Learning	3	3	0	0	30	70	100
20CS4701B	Software Testing Methodologies							
20CS4701C	Cloud Computing							
20CS4701D	Adhoc and Sensor Networks							
Professional Elective Course-4								
20CS4702A	Advanced Data Mining	3	3	0	0	30	70	100
20CS4702B	Software Project Management							
20CS4702C	Cyber Security							
20CS4702D	Reinforcement Learning							
Professional Elective Course-5								
20CS4703A	Big Data Analytics	3	3	0	0	30	70	100
20CS4703B	Distributed Systems							
20CS4703C	User Interface Design							
20CS4703D	Natural Language Processing							
Open Elective Course-3/Job oriented elective								
20CE2701A	Disaster Management and Preparedness	3	3	0	0	30	70	100
20EC2701A	Research Methodology	3	3	0	0	30	70	100
20EC2701B	E waste Management	3	3	0	0	30	70	100
20EE2701A	Non- Conventional Energy Resources	3	3	0	0	30	70	100
20ME2701A	Operations Research	3	3	0	0	30	70	100
20ME2701B	Management Information Systems	3	3	0	0	30	70	100

Open Elective Course-4/Job oriented elective								
20CE2702A	Environmental Management and Audit	3	3	0	0	30	70	100
20EC2702A	Telecommunication	3	3	0	0	30	70	100
20EC2702B	Satellite Communications	3	3	0	0	30	70	100
20EE2702A	Utilization of Electrical Power	3	3	0	0	30	70	100
20ME2702A	Mechatronics	3	3	0	0	30	70	100
20ME2702B	Robotics	3	3	0	0	30	70	100
Humanities and Social Science Elective								
20HS7701C	Entrepreneurship Management	3	3	0	0	30	70	100
20HS7701F	Industrial Engineering Management	3	3	0	0	30	70	100
Skill Oriented Course								
20SA8755	Sales Force Technologies	2	1	0	2	0	50	50
20CS3781B/C	Industrial/Research Internship 2 Months (Mandatory) after third year (to be evaluated during VII semester)	3	0	0	0	0	50	50
	Total Credits	**23**						
Honors in CSE								
20CS6721	Fundamentals of Full Stack Web Development	4	4	0	0	30	70	100
	Advanced Mobile Application Development	4	3	0	2	30	70	100
	Network Programming	4	4	0	0	30	70	100
Honors - MOOCs								
-	MOOC course from Swayam NPTEL	2	0	0	2	-	-	-
-	MOOC course from Swayam NPTEL	2	0	0	2	-	-	-
Minor in CSE								
20CS5701	Cloud Computing	4	4	0	0	30	70	100
Minor MOOCs								
-	MOOC course from Swayam NPTEL	2	0	0	2	-	-	-

L - Lecture T - Tutorial P – Practical

PVP SIDDHARTHA INSTITUTE OF TEHNOLOGY, KANURU, VIJAYAWADA (AUTONOMOUS)

COMPUTER SCIENCE AND ENGINEERING

IV B.Tech – II Semester

Course Code	Title	Credits	L	T	P	Continuous Internal Evaluation	End Semester Examination	Total Marks
20CS3861	Project work, seminar and internship in industry	8	0	0	0	60	140	200

CSE(Honors Moocs)			
S.No.	**Course**	**Duration**	**link**
1	Data analytics with Python	12 Weeks	https://onlinecourses.nptel.ac.in/noc21_cs45/preview
2	Social Networks	12 Weeks	https://onlinecourses.nptel.ac.in/noc21_cs45/preview
3	Foundation of Cloud IOT Edge ML	8 Weeks	https://onlinecourses.nptel.ac.in/noc23_cs65/preview
4	Privacy and Security in Online Social Media	12 Weeks	https://onlinecourses.nptel.ac.in/noc23_cs13/preview
5	GPU Architectures and Programming	12 Weeks	https://onlinecourses.nptel.ac.in/noc20_cs41/preview
6	Information Security - 5 - Secure Systems Engineering	8 Weeks	https://onlinecourses.nptel.ac.in/noc21_cs30/preview
7	Introduction to Industry 4.0 and Industrial Internet of Things.	12 Weeks	https://onlinecourses.nptel.ac.in/noc23_cs82/preview

CSE(Minor in CSE Moocs)			
S.No.	**Course**	**Duration**	**link**
1	Introduction to Database Systems	12 Weeks	https://onlinecourses.nptel.ac.in/noc20_cs03/preview
2	An Introduction to Artificial Intelligence	12 Weeks	https://onlinecourses.nptel.ac.in/noc22_cs56/preview
3	Data Science for Engineers	8 Weeks	https://onlinecourses.nptel.ac.in/noc23_cs17/preview
4	Computer Networks and Internet Protocol	12 Weeks	https://onlinecourses.nptel.ac.in/noc23_cs48/preview
5	Introduction to Soft Computing	8 Weeks	https://onlinecourses.nptel.ac.in/noc22_cs54/preview
6	Foundations of Cyber Physical Systems	12 Weeks	https://onlinecourses.nptel.ac.in/noc23_cs62/preview
7	Introduction to Machine Learning-IITKGP	8 Weeks	https://onlinecourses.nptel.ac.in/noc23_cs87/preview

Communicative English I

Course Code	20HS1101	Year	I	Semester	I
Course Category	Humanities	Branch	CSE	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	Nil
Continuous Internal Evaluation	30	Semester End Evaluation	70	Total Marks	100

Course Outcomes

Upon successful completion of the course, the student will be able to

CO1	Understand the concept of LSRW and basic grammar (L2)
CO2	Apply grammar to various situations (L3)
CO3	Practice different styles of Reading and Comprehending (L3)
CO4	Illustrate the text to process the information for various purposes. (L4)
CO5	Reframe the text for effective communication. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2										√		√		
CO3									√	√		√		
CO4										√		√		
CO5									√	√		√		

Syllabus

Unit No.	Syllabus	Mapped CO‘s
1	**Reading:** Skimming to get the main idea of a text; Scanning to look for specific pieces of information. **Reading for Writing:** Beginnings and endings of paragraphs - Introducing the topic, summarizing the main idea and/or providing a transition to the next paragraph. **Grammar and Vocabulary:** Content words and function words; Word forms: Verbs, Nouns, Adjectives and Adverbs; Nouns: countable and uncountable; singular and plural; Basic sentence structures; Simple Question form - wh-questions; Word order in sentences.	CO1,CO3, CO5
2	**Reading:** Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together. **Writing:** Paragraph writing (specific topics) using suitable cohesive devices; Mechanics of writing - punctuation, capital letters. **Grammar and Vocabulary:** Cohesive devices - linkers, sign posts and transition signals; Use of articles and zero article; prepositions One word substitutes	CO1,C02, CO5
3	**Reading:** Reading a text in detail by making basic inferences - recognizing and interpreting specific context clues; strategies to use text clues for comprehension. **Writing:** Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions. **Grammar and Vocabulary:** Verbs - Tenses; Subject-verb agreement; Direct And Indirect speech, Reporting verbs for academic purposes. Idiomatic expressions	CO1,CO3, CO4,CO5

4	**Reading:** Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data. **Writing:** Information transfer; describe, compare, contrast, identify significance/trends based on information provided in figures/charts/graphs/tables. **Grammar and Vocabulary:** Quantifying expressions - adjectives and adverbs; comparing and contrasting; Degrees of comparison; Use of antonyms **Correction of sentences**	CO1,CO2, CO4,CO5
5	**Reading:** Reading for comprehension. **Writing:** Writing structured essays on specific topics using suitable claims and evidences **Grammar and Vocabulary:** Editing short texts – Identifying and correcting common errors in grammar and usage (Articles, Prepositions, Tenses, Subject-verb agreement) **Prefixes/suffixes**	CO1,CO3, CO5

Learning Resources

Text Books

1. Prabhavathy Y, M.Lalitha Sridevi, Ruth Z. Hauzel, ―English all Round 1: Communication skills for Undergraduate students‖, Orient Black Swan, 2019

Reference Books

1. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.
2. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
3. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012

e- Resources & other digital material

Grammar/Listening/Writing:
1-language.com; http://www.5minuteenglish.com/
https://www.englishpractice.com/

Grammar/Vocabulary:
English Language Learning Online; http://www.bbc.co.uk/learningenglish/
http://www.better-english.com/; http://www.nonstopenglish.com/
https://www.vocabulary.com/; BBC Vocabulary Games
Free Rice Vocabulary Game

Reading:
https://www.usingenglish.com/comprehension/; https://www.englishclub.com/reading/short-stories.htm; https://www.english-online.at/

All Skills:
https://www.englishclub.com/; http://www.world-english.org/
http://learnenglish.britishcouncil.org/

Online Dictionaries:
Cambridge dictionary online; MacMillan dictionary; Oxford learner‘s dictionaries

Calculus and Linear Algebra

Course Code	20BS1101	**Year**	I	**Semester**	I
Course Category	Basic Science	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes

Upon successful completion of the course, the student will be able to

CO1	**Understand** the basic concepts of calculus and linear algebra.(L2)
CO2	**Apply** the echelon form to obtain the solution of system of linear equations and eigen vectors of a matrix.(L3)
CO3	**Apply** the concepts of calculus to find the series expansion and extremum of a given function ,area enclosed by plane curves and volume of the solids. (L3)
CO4	**Analyse** the solution set of linear system of equations and nature of the quadratic forms. (L4)
CO5	**Analyse** the behaviour of functions using mean value theorems, extremum of the given function and limits of integration. (L4)
CO6	**Apply** the concepts of calculus and linear algebra to the given problem and **submit a report**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													√	√
CO2	√								√	√			√	√
CO3	√								√	√			√	√
CO4		√											√	√
CO5		√											√	√
CO6	√								√	√			√	√

Syllabus

Unit No.	Syllabus	Mapped CO's
1	**Matrices-Linear System of Equations:** Rank of a matrix by Echelon form, Normal form, PAQ form, solving system of homogeneous and non-homogeneous linear equations.	CO1,CO2, CO4,CO6
2	**Eigen values and Eigen Vectors:** Eigen values, Eigen vectors and their properties, Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem, diagonalization of a matrix, quadratic forms and nature of the quadratic forms.	CO1,CO2, CO4,CO6
3	**Mean Value Theorems:** Rolle_s Theorem, Lagrange_s mean value theorem, Cauchy_s mean value theorem, Taylor_s and Maclaurin_s theorems with remainders (without proofs).	CO1,CO3, CO5,CO6
4	**Multivariable Calculus:**	CO1,CO3,

	Functions of several variables, Jacobian, Functional dependence, maxima and minima of functions of two variables, method of Lagrange's multipliers.	CO5,CO6
5	**Multiple Integrals:** Double integrals, change of order of integration, double integration in polar coordinates, Triple integrals, change of variables between Cartesian, cylindrical and spherical polar co-ordinates, volume as triple integral. **Application-** Areas enclosed by plane curves.	CO1,CO3, CO5,CO6

Learning Resources
Text Books
1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44/e, 2019. 2. Erwin Kreyszig, Advanced Engineering Mathematics, 9/e, John Wiley & Sons, 2006
Reference Books
1. N.P. Bali and Manish Goyal, A Text book of Engineering Mathematics, Laxmi Publications, 2008.
e- Resources & other digital material
1. https://nptel.ac.in/courses/111/108/111108157/ 2. https://www.nptel.ac.in/courses/111/104/111104125/ 3. https://youtu.be/xDSejIvZmg4 4. http://202.53.81.118/ -> PVPSIT FED-Moodle

Engineering Physics

Course Code	20BS1103	**Year**	I	**Semester**	I
Course Category	Basic Science	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes

Upon successful completion of the course, the student will be able to

CO1	**Understand** the electric, magnetic, optical communication and semiconductor principles in technical aspects. **(L2)**
CO2	**Apply** the knowledge of Physics and optical Principles in optoelectronic devices. **(L3)**
CO3	**Apply** basic laws of electromagnetism and materials for engineering applications**. (L3)**
CO4	**Analyze** the theory of solids and deduce different analytical parameters. **(L4)**
CO5	**Examine** the mechanism of electromagnetic, in sensors and semiconductor devices. **(L4)**
CO6	**Ability** to understand the concepts of optical fibers, the theory of solids, laws of electromagnetism, principles of semiconductor devices and submit a report.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	√													
CO3	√													
CO4		√												
CO5		√												
CO6									√	√		√		

Syllabus

Unit No.	Syllabus	Mapped CO‘s
1	**Fiber Optics:** Introduction, advantages of optical fibers, principle and structure, acceptance angle, numerical aperture, modes of propagation, classification of fibers, fiber optic communication, fiber optic sensors (Temperature, displacement and force), applications.	CO1,CO2 CO5, CO6
2	**Dielectric and Magnetic materials** **Dielectric-materials:** Introduction, electronic polarization, dielectric polarizability, susceptibility and dielectric constant, types of polarizations (Qualitative),frequency dependence of polarization, Lorentz field (quantitative), Clausius-Mossotti equation. **Magnetic materials:** Introduction, magnetic dipole moment, magnetization, magnetic susceptibility and permeability, origin of permanent magnetic moment, classification of magnetic materials, domain theory, hysteresis, soft and hard magnetic materials.	CO1,CO3 CO4, CO6
3	**Electromagnetics:** **Electrostatic field:** Electric potential, Coulombs law and Gauss law, derivation of Coulombs law from Gauss law, applications of Gauss law (line charge, thin sheet of charge and solid charged sphere), Gauss law of electrostatics in dielectric medium, Poisson‘s and Laplace equations. **Magnetostatic field:** Bio–Savart law, Faraday‘s and Ampere‘s laws in integral and differential form, displacement current, continuity equation	CO1,CO3 CO5, CO6

	and Maxwell's equations (qualitatively).	
4	**Semiconductor Physics** Introduction, origin of energy band, intrinsic and extrinsic semiconductors, generation and recombination, carrier concentration in intrinsic semiconductors, variation of Fermi level with temperature in intrinsic semiconductor, n-type and p-type semiconductors, carrier concentration in n type and p type semiconductors, variation of Fermi level with temperature in extrinsic semiconductors.	CO1,CO3, CO4, CO6
5	**Semiconductor Devices** Drift and diffusion currents in semiconductors, Hall effect and its applications, p-n junction diode formation and V-I characteristics, direct and indirect band gap semiconductors, construction and working of photodiode, LED, solar cell	CO1, CO2, CO5, CO6

Learning Resources

Text Books

1. R. K. Gaur, S. L. Gupta, ―Engineering Physics‖, Dhanpat Rai Publications, 8th Edition, 2001.
2. S. O. Pillai, Solid State Physics, New age international publishers, 7th edition (2016)

Reference Books

1. A Text Book of Engineering Physics, M.N.Avadhanulu & P.G.Kshrisagar, S.Chand Publications, fourth edition, 2014.
2. Semiconductor Devices & Physics, S.M.Sze,Wiley, 2008.
3. Applied Physics, P.K. Palanai Swamy, Sci-Tech Publications. December, 2018
4. Engineering Physics, Dr.M.Arumugam, Anuradha Publications, Second edition, 2005.
5. Introduction To Electrodynamics, David.J.Griffths, Pearson Education India Learning Private Limited, Fourth edition, 2015.

e- Resources & other digital material

1. http://physicsforidiots.com/physics/electromagnetism/
2. https://www.arcelect.com/fibercable.htm
3. http://freevideolectures.com/Course/3048/Physics-of-Materials/36
4. https://www.iitk.ac.in/mse/electronic-materials-and-devices
5. https://link.springer.com/chapter/10.1007/978-3-319-48933-9_35

Basic Electrical & Electronics Engineering

Course Code	20ES1101	**Year**	I	**Semester**	I
Course Category	Engineering Science	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes

Upon successful completion of the course, the student will be able to

CO1	Understand the basic concepts of DC circuits, Electrical Machines, Concepts of Electronic Devices and Circuits and realize the Applications of Electrical & Electronics in Interdisciplinary Engineering Domains (L2)
CO2	Apply the basic knowledge of mathematics, science and electrical engineering to obtain the desired parameters of Electric circuits and Machines. (L3)
CO3	Analyse the behaviour of Electric circuits, transformers and Electrical machines. (L4)
CO4	Apply the basic principles of Electronics to solve Analog Circuits. (L3)
CO5	Analyse the characteristics/ performance parameters of Electronic Circuits. (L4)
CO6	Ability to investigate various problems in DC circuits, Electrical Machines and Electronic Devices and Circuits and submit a report.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													√	√
CO2	√												√	√
CO3		√											√	√
CO4	√												√	√
CO5		√											√	√
CO6				√					√	√			√	√

Syllabus

Unit No.	Syllabus	Mapped CO's
1	**Basic laws and Theorems-DC Circuits**: Ohms law, Kirchhoff's Laws, series and parallel resistive circuits, source transformations, delta-wye conversion. Mesh analysis, nodal analysis. Superposition theorem, Thevenin's theorem, Norton's theorem and maximum power transfer theoremwith simple examples (**independent sources only**).	CO1,CO2, CO3,CO6
2	**DC Machines**: Construction, working principle, Voltage Build up, EMF equation, Torque expression, types of excitation, types of dc machines, necessity of Starter, losses and efficiency.	CO1,CO2, CO3,CO6
3	**Transformers**: Construction, working principle, EMF equation, open and short-circuit tests, voltage regulation definition, losses and efficiency. **Three Phase Induction Motors:** Construction, working principle of three phase induction motor.	CO1,CO2, CO3,CO6
4	**Semiconductor Devices**: P-N Junction diode - Basic operating principle, current-voltage characteristics, half-waverectifier, full-waverectifier,rectifiers with filter capacitor, Zener diode as Voltage Regulator.	CO1,CO4, CO5,CO6

5	**Operational Amplifiers**: The Ideal Op Amp, The Inverting Configuration-The closed loop gain, Effect of Finite open-loop gain, The Non-inverting Configuration - The closed loop gain, Characteristics of Non Inverting Configuration, Effect of finite open loop gain, The voltage follower.	CO1,CO4, CO5,CO6

Learning Resources

Text Books

1. D.P.Kothari, I.J.Nagrath, Basic Electrical and Electronics Engineering, 1st Edition, McGraw Hill Education (India) Private Limited, 2017.
2. B.L.Theraja, Fundamentals of Electrical Engineering and Electronics, 1st Edition, S.Chand Publishing, New Delhi, 2006.
3. Millman Jacob, Halkias C Christos, Electronic Devices and Circuits, 2nd Edition, Tata Mcgrawhill Publications, 2007.

Reference Books

1. S.K. Bhattacharya, Basic Electrical and Electronics Engineering, Pearson Education, 2011.
2. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2nd Edition, Pearson Education, 2008.
3. R.K.Rajput, Basic Electrical and Electronics Engineering, University Science Press, New Delhi, 2012.

e- Resources & other digital material

1. http://202.53.81.118/course/view.php?id=122
2. https://nptel.ac.in/courses/108105112/

Problem Solving Techniques

Course Code	20ES1103	**Year**	I	**Semester**	I
Course Category	Engineering Science	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes

Upon successful completion of the course, the student will be able to

CO1	Understand the fundamental concepts of computers, algorithms, flowcharts and problem solving techniques. (L2)
CO2	Apply the basic knowledge of mathematical factoring methods to model an algorithm, flowchart for a given problem. (L3)
CO3	Apply the concept of arrays for implementing merging, sorting, searching, text processing and pattern matching techniques to develop algorithms.(L3)
CO4	Analyze the given problem to develop an efficient solution using sorting or pattern searching techniques. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√													
CO2	√									√				
CO3													√	
CO4		√							√	√				

Syllabus

Unit No.	Syllabus	Mapped CO's
1	**Introduction:** Components of a Computer System, Introduction to Algorithms and Flowcharts. Fundamental Algorithms: Exchanging the values of two variables, Counting, Summation of a set of numbers, Factorial Computation, Generation of Fibonacci sequence, Reversing the digits of an integer.	CO1, CO2
2	**Factoring Methods:** Finding the square root of a number, smallest divisor of an integer, Greatest common divisor of two integers, Generating prime numbers, Computing Prime Factors of an integer, generation of pseudo random numbers, raising a number to a large power, computing nth Fibonacci number	CO1, CO2
3	**Array Techniques:** Array order reversal, Array counting or Histogramming, finding the maximum number in a set, removal of duplicates from an ordered array, partitioning an array, finding the kth smallest element	CO1, CO3
4	**Merging, Sorting and Searching:** The two-way merge, sorting by selection, sorting by exchange, sorting by Insertion, Linear search, binary search.	CO1, CO3, CO4
5	**Text Processing and Pattern Searching:** Keyword searching in text, Text line editing, Linear pattern search, Sublinear pattern search.	CO1, CO3, CO4

Learning Resources
Text Books
1. How to Solve it by Computer, R.G. Dromey, First Edition, 2006, Pearson
Reference Books
1. Fundamentals of Computers, Reema Thareja, Oxford University Press. 2. Flowchart and Algorithm Basics: The Art of Programming, A B Chaudhuri, 2020, Mercury Learning and Information. 3. Algorithms Unlocked, Thomas H. Coremen, 2013, The MIT Press. 4. An Introduction to Programming and Problem Solving with Pascal, Michael Schneider, Steven W. Weingart, David M. Perlman, Second Edition, 2011, Wiley India
e- Resources & other digital material
1. https://onlinecourses.swayam2.ac.in/nou20_cs03/preview 2. https://www.coursera.org/learn/problem-solving?#about 3. https://www.udemy.com/course/flowchartingcourse/ 4. https://raptor.martincarlisle.com/

Communicative English I Lab

Course Code	20HS1151	**Year**	I	**Semester**	I
Course Category	Humanities	**Branch**	CSE	**Course Type**	Lab
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Nil
Continuous Internal Evaluation	15	**Semester End Evaluation**	35	**Total Marks**	50

Course Outcomes

Upon successful completion of the course, the student will be able to

CO1	Acquire communication skills through various language learning activities (L3)
CO2	Construct meaningful sentences and Paragraphs(L3)
CO3	Analyze the text to develop comprehensive ability (L4)
CO4	Preparation of report based on the activity (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1									√	√		√		
CO2										√				
CO3										√		√		
CO4									√	√				

Syllabus

Expt. No.	Syllabus	Mapped CO's
1	Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions.	CO1,CO4
2	Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.	
3	Answering a series of questions about main idea and supporting ideas after listening to audio texts.	CO1,CO2, CO4
4	Discussion in pairs/ small groups on specific topics followed by short structured talks.	
5	Listening for global comprehension and summarizing what is listened to.	CO1,CO3, C04
6	Discussing specific topics in pairs or small groups and reporting what is discussed	
7	Making predictions while listening to conversations/transactional dialogues without video; listening with video	CO1,CO4
8	Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.	
9	Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.	CO1,CO4
10	Formal oral presentations on topics from academic contexts -without the use of PPT slides.	

Learning Resources
Text Books
1. Prabhavathy Y, M.Lalitha Sridevi, Ruth Z. Hauzel, ―English all Round 1: Communication skills for Undergraduate students‖, Orient Black Swan, 2019
Reference Books
1. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition, 2018. 2. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational. 3. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012
e- Resources & other digital material
Grammar/Listening/Writing: 1-language.com http://www.5minuteenglish.com/ https://www.englishpractice.com/ **Listening:** https://learningenglish.voanews.com/z/3613; http://www.englishmedialab.com/listening.html **Speaking:** https://www.talkenglish.com/BBC; Learning English – Pronunciation tips Merriam-Webster – Perfect pronunciation Exercises All Skills: https://www.englishclub.com/; http://www.world-english.org/ http://learnenglish.britishcouncil.org/ **Online Dictionaries:** Cambridge dictionary online; MacMillan dictionary; Oxford learner‘s dictionaries

Engineering Physics Lab

Course Code	20BS1152	**Year**	I	**Semester**	I
Course Category	Basic Science	**Branch**	CSE	**Course Type**	Practical
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Nil
Continuous Internal Evaluation	15	**Semester End Evaluation**	35	**Total Marks**	50

Course Outcomes

Upon successful completion of the course, the student will be able to

CO1	Demonstrate the importance of dielectric material and measure magnetic parameters. [L3]
CO2	Identify the type of semiconductor using hall effect and measure the energy band gap. [L3]
CO3	Examine the characteristics of photodiode, p-n junction diode and solar cell. [L4]
CO4	Assess the intensity of the magnetic field of circular coil carrying current with distance and measure resistance using four probe method. [L4]
CO5	Estimate the acceptance angle of an optical fiber and numerical aperture. [L4]
CO6	Summarize and tabulate the experimental observations and output.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√			√								√		
CO2	√			√								√		
CO3	√			√								√		
CO4	√			√								√		
CO5	√			√								√		
CO6	√			√								√		

Syllabus

Expt. No.	Syllabus	
1	Determine the Dielectric Constant of various Solid samples.	
2	Determine the Magnetic Susceptibility by Gouy‘s Method.	
3	Determine the Hall Coefficient using Hall Effect experiment.	CO2,CO6
4	Determine the Energy Band gap of a Semiconductor.	
5	Study the characteristic curves of a Photo Diode.	
6	Illustrate the V-I the characteristics of P-N junction Diode.	
7	Draw the V-I characteristics of a Solar Cell.	
8	Determine The Magnetic Field along the axis of a Circular Coil carrying current.	
9	Determine the Resistivity of Semiconductor by Four Probe Method.	
10	Determine the Numerical Aperture of a given Optical Fibre and Find its Acceptance Angle.	

Learning Resources
Text Books
1. RamaraoSri, Choudary Nityanand and Prasad Daruka, ‖Lab Manual of Engineering Physics‖ Vth ed., Excell Books, 2010
Reference Books
1. Semiconductor Devices & Physics, S.M.Sze,Wiley,2008.
e- Resources & other digital material
1. https://nptel.ac.in/courses/115/105/115105120/ 2. https://nptel.ac.in/courses/115/107/115107095/ 3. https://nptel.ac.in/courses/115/104/115104109/ 4. http://www.physicsclassroom.com/The-Laboratory 5. https://www.vlab.co.in/broad-area-physical-sciences 6. https://www.niser.ac.in/sps/teaching-laboratories

Basic Electrical & Electronics Engineering Lab

Course Code	20ES1151	**Year**	I	**Semester**	I
Course Category	Engineering Science	**Branch**	CSE	**Course Type**	Lab
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Nil
Continuous Internal Evaluation	15	**Semester End Evaluation**	35	**Total Marks**	50

Course Outcomes

Upon successful completion of the course, the student will be able to

CO1	Apply techniques/procedures of Electrical & Electronics Engineering to solve problems (L3).
CO2	Conduct experiments as a team / individual by using equipment available in the laboratory.
CO3	Examine the network theorems and Kirchhoff‘s laws for DC electrical circuits (L4).
CO4	Analyse the open circuit characteristic of DC shunt generator and efficiency of single phase transformer (L4).
CO5	Analyse the characteristics/ performance parameters of Electronic and Analog Circuits. (L4)
CO6	make an effective report based on experiments

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√			√										
CO2				√	√				√				√	√
CO3		√		√										
CO4		√		√										
CO5		√		√										
CO6				√						√			√	√

Syllabus

Expt. No.	Syllabus	Mapped CO‘s
	Conduct any ten experiments	
1	Verification of Kirchhoff_s Laws KVL and KCL.	CO1,CO2, CO3,CO6
2	Verification of DC Superposition Theorem.	CO1,CO2, CO3,CO6
3	Verification of Thevenin's Theorem and Norton's Theorem.	CO1,CO2, CO3,CO6
4	Open circuit characteristics/magnetization characteristics of DC shunt generator.	CO1,CO2, CO4,CO6
5	OC and SC Tests on single phase transformer.	CO1,CO2, CO4,CO6
6	Voltage Current Characteristics of a p-n Junction Diode.	CO1,CO2, CO5,CO6
7	Half wave rectifier with and without filter.	CO1,CO2, CO5,CO6
8	Full wave rectifier with and without filter.	CO1,CO2, CO5,CO6
9	Voltage Regulation with Zener Diode.	CO1,CO2, CO5,CO6
10	Inverting and Non-inverting Amplifier Design with Op-amp.	CO1,CO2, CO5,CO6

11	Verification of KCL and KVL using PSPICE.	CO1,CO2, CO3,CO6
12	Verification of Network Theorems using PSPICE.	CO1,CO2, CO3,CO6
13	Diode and Transistor Circuit Analysis using PSPICE.	CO1,CO2, CO5,CO6
14	Inverting and Non-inverting Amplifier Design with Op-ampusing PSPICE.	CO1,CO2, CO5,CO6

Learning Resources

Text Books

1. D.P.Kothari, I.J.Nagrath, Basic Electrical and Electronics Engineering, 1st Edition, McGraw Hill Education (India) Private Limited, 2017.
2. B.L.Theraja, Fundamentals of Electrical Engineering and Electronics, 1st Edition, S.Chand Publishing, New Delhi, 2006.
3. Millman Jacob, Halkias C Christos, Electronic Devices and Circuits, 2nd Edition, Tata Mcgrawhill Publications, 2007.

Reference Books

1. S.K. Bhattacharya, Basic Electrical and Electronics Engineering, Pearson Education, 2011.
2. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2nd Edition, Pearson Education, 2008.
3. R.K.Rajput, Basic Electrical and Electronics Engineering, University Science Press, New Delhi, 2012.

e- Resources & other digital material

1. http://202.53.81.118/course/view.php?id=122
2. https://nptel.ac.in/courses/108105112/

Communicative English II

Course Code	20HS1201	**Year**	I	**Semester**	II
Course Category	Humanities	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes

Upon successful completion of the course, the student will be able to

CO1	Understand various Linguistic aspects (L2)
CO2	Apply language to draft letters for various business purposes(L3)
CO3	Interpret the text for information processing and effective communication. (L3)
CO4	Analyze the data for report writing and précis writing. (L4)
CO5	Relate advanced writing skills for better employability. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2									√	√		√		
CO3									√	√		√		
CO4									√	√		√		
CO5									√	√		√		

Syllabus

Unit No.	Syllabus	Mapped CO's
1	**Reading:** Reading for presenting - strategies to select, compile and synthesize information for presentation-Comprehending a wide range of texts -Reading to recognize academic style **Reading for Writing:** Paraphrasing - using quotations and in-text references; using academic style - avoiding colloquial words and phrases - Writing an essay after researching a topic - Citing the sources used **Grammar and Vocabulary:** Academic verbs in context; formal words and phrases-Awareness about Root words	CO1, CO3, CO5
2	**Reading:** Recognizing formal and informal styles -Recognizing the difference between facts and opinions - Identifying and understanding different perspectives **Writing:** Letter writing and e mail writing - Structure, Conventions and Etiquette – Informal, semi-formal and formal (enquiry, complaints, seeking permission, seeking internship - Re-draft a piece of text from a different perspective - Writing brief critical reviews of short texts. Communication skills-verbal /Non verbal **Grammar and Vocabulary:** Agreement: Subject-verb, Noun-pronoun; Editing short texts - Phrasal verbs - Phrasal prepositions - Avoiding clichés	CO1,CO2, CO4, CO5
3	**Reading:** Identifying claims, evidences, views/opinions, purpose, and stance/position -Understand the correlation between a talk and a reading text based on inferences made. **Writing:** Writing structured analytical and argumentative essays on general topics using suitable claims and evidences with the sources cited-Peer review of the essays written **Grammar and Vocabulary:** Language for different functions such as stating a point, expressing opinion, Agreeing/disagreeing, Adding information to what	CO1, CO3, CO5

	someone has stated, and asking for clarification - Modifiers and misplaced modifiers. Corporate grooming	
4	**Reading:** Reading varied text types - Structure and contents of a formal report - Sections in a report and understanding the purpose of each section- Significance of references **Writing:** Writing reports **Grammar and Vocabulary:** Active and passive voice - Use of passive verbs in academic writing- **Precis writing**	CO1, CO3 CO4, CO5
5	**Reading:** Reading for inferential comprehension **Writing:** Writing one‘s CV and cover letter - Applying for a job/internship **Grammar and Vocabulary:** Reinforcing learning **-** Edit one‘s writing to correct common errors in grammar and usage **-** Use appropriate vocabulary for speaking and writing – Various purposes, Jumbled sentences	CO1, CO2, CO5

Learning Resources

Text Books

1. Prabhavathy Y, M.Lalitha Sridevi ―English all Round2: Communication skills for Undergraduate students‖, Orient Black Swan, 2020

Reference Books

1. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.
2. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
3. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012(Student Book, Teacher Resource Book, CD & DVD)

e- Resources & other digital material

Grammar/Listening/Writing:
1-language.com; http://www.5minuteenglish.com/ https://www.englishpractice.com/
Grammar/Vocabulary:
English Language Learning Online; http://www.bbc.co.uk/learningenglish/
http://www.better-english.com/; http://www.nonstopenglish.com/
https://www.vocabulary.com/; BBC Vocabulary Games
Free Rice Vocabulary Game
Reading:
https://www.usingenglish.com/comprehension/; https://www.englishclub.com/reading/short-stories.htm; https://www.english-online.at/
All Skills:
https://www.englishclub.com/; http://www.world-english.org/ http://learnenglish.britishcouncil.org/
Online Dictionaries:
Cambridge dictionary online; MacMillan dictionary; Oxford learner‘s dictionaries

Engineering Chemistry

Course Code	20BS1202	**Year**	I	**Semester**	II
Course Category	Basic Science	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes

Upon successful completion of the course, the student will be able to

CO1	Understand the basic principles related to renewable energy sources, energy systems, metal finishing and materials (L2)
CO2	Apply the knowledge of energy transformation principles to classify and describe the working of electrodes and cells (L3)
CO3	Apply suitable methods for metal finishing and advanced techniques for the characterization of nano materials (L3)
CO4	Analyse the performance of different electrochemical techniques, energy conversion systems, polymers and nano materials in their respective applications (L4)
CO5	Make an effective report on various concepts and technologies related to Engineering chemistry.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	√						√					√	√	
CO3	√						√					√	√	
CO4	√						√					√	√	
CO5	√						√			√		√	√	

Syllabus

Unit No.	Syllabus	Mapped CO's
1	ELECTROCHEMICAL ENERGY SYSTEMS Introduction-Origin of electrode potential, Electrode Potentials, Measurement of Electrode Potentials, Nernst Equation for a single electrode, EMF of a cell, Types of Electrodes or Half Cells-Hydrogen and Calomel electrode, Electrochemical Cell, Galvanic Cell vs Electrolytic Cell, Electrochemical conventions, Types of Ion Selective Electrodes- glass membrane electrode, polymer membrane electrodes, solid state electrodes, gas sensing electrodes (classification only), Concentration Cells.	CO1,CO2, CO4,CO5
2	BATTERY TECHNOLOGY Basic concepts, battery characteristics, classification of batteries, Important applications of batteries, Classical batteries-dry/Leclanche cell, Modern batteries-zinc air, lithium cells-Li Mno2 cell- challenges of battery technology. Fuel cells- Introduction - classification of fuel cells – hydrogen and oxygen fuel cell, propane and oxygen fuel cell- Merits of fuel cell.	CO1,CO2, CO4,CO5
3	RENEWABLE SOURCES OF ENERGY Introduction- sources of renewable energy Solar energy – Introduction - Physical and Chemical properties of Silicon- Production of Solar Grade Silicon from Quartz - Doping of Silicon- p and n type semi conductors- PV cell / solar cell- Manufacturing of Photovoltaic Cells using Chemical Vapor Deposition Technique-applications of solar energy	CO1,CO2, CO4,CO5

4	METAL FINISHING Technological importance of metal finishing, methods of metal finishing, manufacturing of electronic components, electrochemical techniques of forming, machining and etching, electrolytic cell, principle of electroplating, nature of electrodeposits, electroplating process, Electroplating of chromium, gold etc. Electroless plating of copper, nickel	CO1,CO3, CO4,CO5
5	POLYMERS & NANOMATERIALS Polymers: Introduction thermoplastic and thermo setting resins, Preparation, properties and uses of polystyrene and Polyphosphazines., differences between Nanomaterials: Introduction to nanomaterial: nanoparticles, nanocluster, carbon nanotube (CNT) and nanowires. Chemical synthesis of nanomaterials: sol-gel method. Characterization: Principle and applications of scanning electron microscope (SEM) and transmission electron microscope (TEM).	CO1,CO3, CO4,CO5

Learning Resources

Text Books

1. P.C. Jain and M. Jain, Engineering Chemistry, 15/e, DhanapatRai& Sons, Delhi (2014).
2. B.K. Sharma, Engineering Chemistry, Krishna Prakashan, Meerut.
3. O G Palanna, Engineering Chemistry, Tata McGraw Hill (2009).

Reference Books

1. Sashichawla, A Textbook of Engineering Chemistry, DhanapathRai and sons, (2003)
2. B.S Murthy and P. Shankar, A Text Book of NanoScience and NanoTechnology, University Press (2013).
3. S.S. Dara, A Textbook of Engineering Chemistry, S.Chand& Co, (2010)
4. N.Krishna Murthy and Anuradha, A text book of Engineering Chemistry, M murthyPublications (2014).
5. K. SeshaMaheshwaramma and Mridula Chugh, Engineering Chemistry, Pearson India Edn services, (2016).

e- Resources & other digital material

1. https://nptel.ac.in/courses/105105178/
2. http://202.53.81.118/course/view.php?id=82

Probability and Statistics

Course Code	20BS1204	**Year**	I	**Semester**	II
Course Category	Basic Science	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes

Upon successful completion of the course, the student will be able to

CO1	Understand the basic concepts of probability and statistics (L2).
CO2	Calculate the measures of central tendencies, correlation and regression to the given data and apply appropriate probability distributions to the given problem (L3).
CO3	Apply the concepts of testing hypothesis for large and small samples (L3).
CO4	Connect the concepts of probability, correlation and regression to real life problems (L4).
CO5	Identify appropriate test statistic to test given hypothesis for statistical decision (L4).
CO6	Apply the concepts of probability and statistics to the given data and submit the report.(L3)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													√	√
CO2	√								√	√			√	√
CO3	√								√	√			√	√
CO4		√											√	√
CO5		√											√	√
CO6	√								√	√			√	√

Syllabus

Unit No.	Syllabus	Mapped CO's
1	**Measures of Central Tendency and Probability:** **Measures of central tendency** : Mean, Median, Mode **Probability**: Probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem (without proof).	CO1,CO2, CO4,CO6
2	**Random Variable and Probability Distributions:** Random variables (discrete and continuous), probability density functions, probability distribution - Binomial, Poisson and normal distribution-their properties (mathematical expectation and variance).	CO1,CO2, CO4,CO6
3	**Correlation, Regression:** Correlation, correlation coefficient, rank correlation, regression, lines of regression, regression coefficients, principle of least squares and curve fitting (straight Line, parabola and exponential curves).	CO1,CO2, CO4,CO6
4	**Testing of Hypothesis and Large Sample Tests:** Formulation of null hypothesis, alternative hypothesis, the critical region, two types of errors, level of significance. **Large Sample Tests**: Test for single proportion, difference of proportions, test for single mean and difference of means. Confidence interval for parameters in one sample and two sample problems	CO1,CO3, CO5,CO6
5	**Small Sample Tests:** Student t-distribution (test for single mean, two means and paired t-test), testing of equality of variances (F-test), $\chi 2$ - test for goodness of fit, $\chi 2$- test for independence of attributes.	CO1,CO3, CO5,CO6

Learning Resources
Text Books
1. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012. 2. Dr.T.K.V. Iyengar, Dr.B.Krishna Gandhi, S. Ranganatham, Dr. M.V.S.S.N. Prasad, Probability & Statistics, Publications: S.Chand, 4th Revised Edition, 2012.
Reference Books
1. S. Ross, A First Course in Probability, Pearson Education India, 2002. 2. Miller and Freunds, Probability and Statistics for Engineers,7/e, Pearson, 2008
e- Resources & other digital material
1. https://nptel.ac.in/courses/111/106/111106150/ 2. https://nptel.ac.in/courses/111105035 3. http://202.53.81.118/ -> PVPSIT FED-Moodle

Programming for Problem Solving

Course Code	20ES1202	**Year**	I	**Semester**	II
Course Category	Engineering Science	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Problem Solving Techniques
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes

Upon successful completion of the course, the student will be able to

CO1	Understand the principles of structured programming and C constructs for solving problems. (L2)
CO2	Apply suitable control constructs and array concepts to solve problems. (L3)
CO3	Apply the concept of pointers, user defined data types and files to solve problems. (L3)
CO4	Analyze the given problem and use modular programming approach to develop solutions. (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√													
CO2	√									√				
CO3												√	√	
CO4		√								√				

Syllabus

Unit No.	Syllabus	Mapped CO's
1	**Introduction to C:** Introduction, Structure of C Program, A Simple C Program, C-Tokens, Basic Data types, Variables, Constants, Input / Output statements, Operators, Type conversion and Type casting. **Conditional Branching Statements:** if, if-else, if-else-if Statements and Switch case.	CO1, CO2
2	**Iterative Statements:** while, do-while and for loops, Nested loops, break and continue statements. **Arrays:** Declaration, Accessing array elements, Storing values, Operations on arrays, Multi-dimensional arrays. **Strings:** Introduction, String manipulation functions.	CO1, CO2
3	**Functions:** Introduction, Function declaration, Function definition and Function call, Types of Functions, Parameter passing, Passing arrays to functions, Recursion, Storage classes, Command line arguments.	CO1, CO4
4	**Pointers:** Declaration and Initialization of pointer variables, Pointer arithmetic, Pointers and arrays, Pointer to pointer, Array of pointers, Pointers and functions, Dynamic memory allocation. **Pre-processor directives:** The #define Directive, Undefining a Macro, Token Pasting and Stringizing Operators, The #include Directive, Conditional Compilation.	CO1, CO3
5	**User defined data-types:** Introduction, bit-fields, Nested structures, Array of structures, Structures and functions, Unions, enum, typedef. **Files in C:** Using Files in C, Read data from files, Writing data to files, Random access to files of records.	CO1, CO3

Learning Resources

Text Books
1. Programming in C, ReemaThareja, AICTE Edition, 2018, Oxford University Press
Reference Books
1. Computer Science: A Structured Programming Approach Using C, B. A. Forouzan and R.F. Gilberg, Third Edition, 2007, Cengage Learning. 2. Programming in C, PradipDey, Manas Ghosh, AICTE Edition, Oxford University Press. 3. Programming with C, B. Gottfried, Third Edition, 2017, Schaum's outlines, McGraw Hill. 4. Problem Solving & Program Design in C,Jeri R. Hanly,Ellot B. Koffman,5th Edition, Pearson.
e- Resources & other digital material
1. http://cprogramminglanguage.net/ 2. https://www.geeksforgeeks.org/c-programming-language/ 3. https://www.greatlearning.in/academy/learn-for-free/courses/c-programming 4. https://www.udemy.com/course/the-complete-c-programming/ 5. https://nptel.ac.in/courses/106/105/106105171/

Engineering Graphics

Course Code	20ES1204	**Year**	I	**Semester**	II
Course Category	Engineering Science	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	1-0-4	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes

Upon successful completion of the course, the student will be able to

CO1	Construct conic sections and curves used in Engineering practice. (L3)
CO2	Construct orthographic projections of an object when its position is defined with respect to the reference planes. (L3)
CO3	Develop the isometric view for the given orthographic projections and vice versa. (L3)
CO4	Develop the lateral surfaces of solids. (L3)
CO5	Identify the appropriate commands that are used to prepare the given drawing in CAD environment. (L3)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√	√							√	√	√		√	
CO2	√	√							√	√	√		√	
CO3	√	√							√	√	√		√	
CO4	√	√							√	√	√		√	
CO5	√				√				√	√	√		√	

Syllabus

Unit No.	Syllabus	Mapped CO's
1	**Introduction to Engineering Graphics**: Principles of Engineering Graphics and their significance- Conventions in drawing, lettering, dimensioning, BIS conventions. a) **Conic sections**: Construction of ellipse, parabola and hyperbola (general method only) b) **Cycloidal curves**: Cycloid, Epicycloid and Hypocycloid c) **Involutes**: Involute of regular polygons and Circle.	CO1
2	**Projection of points, lines and planes:** Projection of points in different quadrants, lines inclined to one and both the reference planes, finding true length and inclination made by the line. Projections of regular plane surfaces.	CO2
3	**Projections of solids:** Projections of regular solids such as cube, prism, pyramid, cylinder and cone (Treatment limited to solids inclined to one of the reference planes). **Sections of solids**: Section planes and sectional view of right regular Solids- cube, prism, cylinder, pyramid and cone. True shape of the section. (Treatment limited to the solids perpendicular to one of the principal planes)	CO2
4	**Orthographic Views**: Systems of projections, conversion of Isometric view to orthographic view. **Isometric Projections**: Principles of Isometric projection- Isometric scale; **Isometric views**: lines, planes and solids. (Treatment is limited to simple objects only)	CO3

5	**Development of surfaces:** Development of lateral surfaces of right regular solids-prism, cylinder, pyramid, cone and their sectional parts. (Treatment limited to solids perpendicular to one of the principal planes)	CO4
	Introduction to CAD: Basic drawing, editing and dimensioning commands: line, polyline, circle, arc, polygon, ellipse, rectangle, erase, undo, redo, snap, move, copy, rotate, scale, mirror, offset, layer, trim, extend, fillet, chamfer, array, linear and angular dimension.	CO5

Learning Resources

Text Books

1. N.D. Bhatt, Engineering Drawing, 53/e, Charotar Publishers,2016.
2. K.L. Narayana&P.Kannaiah,EngineeringDrawing,3/e,ScitechPublishers,2012

Reference Books

1. Dhanajay A Jolhe, Engineering Drawing, Tata McGraw-Hill,2009.
2. Shah and Rana, Engineering Drawing, 2/e, Pearson Education,2009.
3. K.Venugopal,EngineeringDrawingandGraphics,6/e,NewAgePublishers,2011.
4. K.C. John, Engineering Graphics, 2/e, PHI,2013.
5. Basant Agarwal and C.M. Agarwal, Engineering Drawing, TataMcGrawHill,2008.

e- Resources & other digital material

1. http://www.youtube.com/watch?v=XCWJ XrkWco, Accessed on 01-06-2017.
2. http://www.me.umn.edu/courses/me2011/handouts/drawing/blanco-tutorial.html#isodrawing, Accessed on 01-06-2017.
3. http://www.slideshare.net, Accessed on 01-06-2017.
4. http://edpstuff.blogspot.in, Accessed on 01-06-2017.

Communicative English II Lab

Course Code	20HS1251	**Year**	I	**Semester**	II
Course Category	Humanities	**Branch**	CSE	**Course Type**	Lab
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Nil
Continuous Internal Evaluation	15	**Semester End Evaluation**	35	**Total Marks**	50

Course Outcomes

Upon successful completion of the course, the student will be able to

CO1	Hone employability skills (L3)
CO2	Develop an ability of making discussions, inferences and presentations (L3)
CO3	Refine communication skills through various strategies (L4)
CO4	Process the information in different contexts (L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1									√	√		√		
CO2									√	√		√		
CO3									√	√		√		
CO4									√	√		√		

Syllabus

Expt. No.	Syllabus	Mapped CO's
1	**Listening for presentation strategies and answering questions on the speaker, audience, and key points**	CO1, CO2, CO4
2	Formal presentations using PPT slides (individual)	
3	Relating a reading text to a talk/presentation – understanding different perspectives and drawing inferences	CO1, CO2, CO4
4	Formal team presentations using PPT slides/audio- visual aids	
5	Identifying views and opinions expressed by different speakers while listening to discussions	CO1, CO3, C04
6	Group discussion on general topics	
7	Processing of information using context clues while listening to talks/lectures	CO1, CO3, CO4
8	Role plays – people from various fields of work	
9	Processing of explicit information presented in the text and implicit information inferable from the text or from previous/background knowledge	CO1, CO3, CO4
10	Mock interviews for jobs/internships	

Learning Resources
Text Books
1. Prabhavathy Y, M.Lalitha Sridevi. ―English all Round 2: Communication skills for Undergraduate Learners‖, Orient Black Swan, 2020
Reference Books
1. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition, 2018. 2. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational. 3. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012

e- Resources & other digital material
Grammar/Listening/Writing: 1-language.com http://www.5minuteenglish.com/ https://www.englishpractice.com/ **Listening:** https://learningenglish.voanews.com/z/3613; http://www.englishmedialab.com/listening.html **Speaking:** https://www.talkenglish.com/BBC; Learning English – Pronunciation tips Merriam-Webster – Perfect pronunciation Exercises **All Skills:** https://www.englishclub.com/; http://www.world-english.org/ http://learnenglish.britishcouncil.org/ **Online Dictionaries:** Cambridge dictionary online; MacMillan dictionary; Oxford learner‘s dictionaries

Engineering Chemistry Lab

Course Code	20BS1251	**Year**	I	**Semester**	II
Course Category	Basic Science	**Branch**	CSE	**Course Type**	Lab
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Nil
Continuous Internal Evaluation	15	**Semester End Evaluation**	35	**Total Marks**	50

Course Outcomes

Upon successful completion of the course, the student will be able to

CO1	Demonstrate the working of instruments such as pH meter and Conduct meter.(L3)
CO2	Apply the acquired knowledge to determine the quantity of metal ions in a given solution(L3)
CO3	Estimate the amount of active chlorine in bleaching powder.(L4)
CO4	Compare the viscosities and surface tension of different liquids(L4)
CO5	Analyze different compounds and examine the preparation of different polymers (L4)
CO6	Make an effective report based on experiments

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√		√				√						√	
CO2	√		√				√						√	
CO3	√		√				√						√	
CO4	√		√				√						√	
CO5	√		√				√						√	
CO6	√		√				√			√			√	

Syllabus

Expt. No.	Syllabus	Mapped CO's
1	Determination of strength of an acid by pH metric method	CO1,CO6
2	Determination of conductance by conducto metric method	
3	Determination of viscosity of a liquid	CO4,CO6
4	Determination of surface tension of a liquid	
5	Determination of chromium (VI) in potassium dichromate	CO2,CO6
6	Determination of Zinc by EDTA method	
7	Estimation of active chlorine content in Bleaching powder	CO3,CO6
8	Preparation of Phenol-Formaldehyde resin	CO5,CO6
9	Preparation of Urea-Formaldehyde resin	
10	Thin layer chromatography(paper chromatography)	

Learning Resources

Text Books

1. N.KBhasin and Sudha Rani Laboratory Manual on Engineering Chemistry 3/e, DhanpatRai Publishing Company (2007).

Reference Books

1. Mendham J, Denney RC, Barnes JD, Thosmas M and Sivasankar B Vogel's Quantitative Chemical Analysis 6/e, Pearson publishers (2000).

e- Resources & other digital material

1. https://nptel.ac.in/courses/105105178/
2. http://202.53.81.118/course/view.php?id=82

Programming for Problem Solving Lab

Course Code	20ES1253	**Year**	I	**Semester**	II
Course Category	Engineering Science	**Branch**	CSE	**Course Type**	Lab
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Nil
Continuous Internal Evaluation	15	**Semester End Evaluation**	35	**Total Marks**	50

Course Outcomes

Upon successful completion of the course, the student will be able to (L3)

CO1	Apply Structured Programming/C constructs for solving problems (L3).
CO2	Implement programs as an individual on different IDEs/ online platforms. (L3)
CO3	Develop an effective report based on various programs implemented. (L3)
CO4	Apply technical knowledge for a given problem and express with an effective oral communication. (L4)
CO5	Analyze outputs using given constraints/test cases.(L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													√	
CO2					√				√					
CO3										√				
CO4	√									√				
CO5			√											

Syllabus

Expt. No.	**Syllabus**	**Mapped CO's**
1	Draw flowcharts for fundamental algorithms.	CO1,CO2, CO3,CO4,CO5
2	C Programs to demonstrate C-tokens.	CO1,CO2, CO3,CO4,CO5
3	C Programs on usage of operators.	CO1,CO2, CO3,CO4,CO5
4	C Programs to demonstrate Decision making and branching (Selection)	CO1,CO2, CO3,CO4,CO5
5	C programs to demonstrate different loops.	CO1,CO2, CO3,CO4,CO5
6	C programs to demonstrate 1-D arrays.	CO1,CO2, CO3,CO4,CO5
7	C programs to demonstrate multi-dimensional arrays.	CO1,CO2, CO3,CO4,CO5
8	C programs to perform operations on strings with String handling functions and without String handling functions.	CO1,CO2, CO3,CO4,CO5
9	C programs to demonstrate functions.	CO1,CO2, CO3,CO4,CO5
10	C programs on pointers.	CO1,CO2, CO3,CO4,CO5
11	C programs on structures and unions.	CO1,CO2, CO3,CO4,CO5
12	C programs to demonstrate files.	CO1,CO2,

		CO3,CO4,CO5

Learning Resources

Text Books

1. Programming in C, Reema Thareja, AICTE Edition, 2018, Oxford University Press

Reference Books

1. Computer Science: A Structured Programming Approach Using C, B. A. Forouzan and R.F. Gilberg, Third Edition, 2007, Cengage Learning.
2. Programming in C, Pradip Dey, Manas Ghosh, AICTE Edition, Oxford University Press.
3. Programming with C, B. Gottfried, Third Edition, 2017, Schaum's outlines, McGraw Hill (India).
4. Problem Solving and Program Design in C, Jeri R. Hanly, Ellot B. Koffman, Fifth Edition, Pearson.

e- Resources & other digital material

1. http://cprogramminglanguage.net/
2. https://www.geeksforgeeks.org/c-programming-language/
3. https://nptel.ac.in/courses/106105085/4

Life Sciences for Engineers

Course Code	20MC1201	**Year**	I	**Semester**	II
Course Category	Mandatory	**Branch**	CSE	**Course Type**	Theory
Credits	0	**L-T-P**	2-0-2	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes

Upon successful completion of the course, the student will be able to

CO1	Apply the concepts of biology to create tangible and economically viable engineering goods.((L3)
CO2	Analyse new technologies in Genetics biotechnology, pharmaceutical, medical and agricultural fields from the knowledge gained from DNA technology.(L4)
CO3	Apply the knowledge of biology to improve the living standards of societies.(L3)
CO4	Apply the basic knowledge of genetics and DNA technology for disease diagnostics and therapy.(L3)
CO5	Analyse new technologies in biotechnology, pharmaceutical, medical and agricultural fields from the knowledge gained from DNA technology.(L4)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√									√				√
CO2					√					√				√
CO3					√					√				√
CO4					√	√				√				√
CO5	√					√				√				√

Syllabus

Unit No.	Syllabus	Mapped CO's
1	**Introduction to Biology** Comparison of Biological organisms with manmade systems :Eye and Camera ,Flying bird and Aircraft Ultra structure of cell: Prokaryotes and Eukaryotes	CO1
2	**Bio-molecules** Structure and functions of proteins (antibodies) Structure and functions of nucleic acids Industrial applications- Enzymes and Fermentation	CO1 CO2
3	**Bioenergetics and Cellular Respiration** Mechanism of photosynthesis Glycolysis TCA cycle Electron transport chain and Oxidative phosphorylation.	CO3
4	**Genetics** Mendel'slaws Gene mapping Single gene disorders in humans	CO3 CO4
5	**Recombinant DNA Technology** Recombinant vaccines, transgenic microbes, plants and animals. Animal cloning, biosensors, biochips.	CO2 CO5

Expt. No.	Name of the experiment	Mapped CO's
1	Dissect & mount different parts of plants using Microscope	CO1
2	Estimation of Proteins by using Biuret method	CO2
3	Estimation of enzyme activity.	CO2
4	Estimation of chlorophyll content in some selected plants.	CO3
5	Nitrogen Cycle: Estimation of Nitrates /Nitrites in soil by using Spectrophotometer	CO3
6	Mendal's laws and gene mapping	CO4, CO5

Learning Resources

Text Books

1. Biology for Engineers-Wiley Editorial
2. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, ―Biology: A global approach‖, Pearson Education Ltd, 2018.
3. Biotechnology by U.Satyanarayana, Alliedand books Pvt. ltd. Kolkata

Reference Books

1. Alberts et al., The molecular biology of the cell, 6/e, Garland Science, 2014.
2. John Enderle and Joseph Bronzino Introduction to Biomedical Engineering, 3/e, 2012

Discrete Mathematical Structures

Course Code	20BS1303	**Year**	II	**Semester**	I
Course Category	Basic Sciences	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Basic Mathematics
Continuous Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the fundamental concepts of discrete mathematical structures	**L2**
CO2	Apply Normal forms/Rules of Inference for solving suitable problems.	**L3**
CO3	Apply the method of characteristic roots for solving different recurrence relations and make an effective document.	**L3**
CO4	Analyze various graph techniques to construct a tree.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√													
CO2	√									√				
CO3										√			√	
CO4		√							√	√				

Syllabus		**Mapped CO**
Unit No.	**Contents**	
I	**Mathematical Logic:** Introduction-Statements and Notations-Connectives(Negation,Conjunction,Disjunction)-Statement formulas and Truth Tables, Conditional and Bi-conditional, Well-Formed Formulas, Tautologies, Equivalence of Formulas, Duality Law, Tautological Implication, Functionally Complete Sets of Connectives, Other Connectives. **Normal Forms:** Disjunctive Normal Forms (DNF), Conjunctive Normal Forms (CNF), Principal of Disjunctive Normal Forms (PDNF), Principal of Conjunctive Normal Forms (PCNF).	**CO1, CO2**

II	**Theory of Inference for Statement Calculus:** Validity using Truth Tables-Rules of Inference – Consistency of Premises and Indirect Method Proof. **Predicate calculus:** Introduction to Predicates - Statement functions, Variable and Quantifiers- Predicate Formulas-Free and Bound Variables-Universe of Discourse.	**CO1,CO2**
III	**Recurrence Relations**-The Method of Characteristic Roots-Solutions in Inhomogeneous Recurrence Relation.	**CO1,CO3**
IV	**Relations and Directed Graphs**-Special Properties of Binary Relations- Equivalence Relations- Ordering Relations, Lattices, and Enumerations- Operations on Relations- Paths and Closures-Directed Graphs and Adjacency Matrices	**CO1,CO4**
V	**Graphs-** Basic Concepts- Isomorphism‘s and Sub graphs-Trees and Their Properties - Spanning Trees-Planar Graphs-Euler's Formula- Multi-graphs and Euler Circuits-Hamiltonian Graphs- Chromatic Numbers.	**CO1,CO4**

Learning Resources

Text Books

1. Discrete Mathematical Structures with Applications to Computer Science , J P Trembly and R Manohar, 1988, McGraw-Hill **(Unit-I,II)**
2. Discrete Mathematics for Computer Scientists & Mathematicians, Joe L. Mott. Abraham Kandel and Theodore P. Baker, Second Edition, 2017, PHI. **(Unit-III,IV,V)**

References

1. Discrete Mathematics and its Applications, Kenneth H. Rosen, Seventh Edition, 2017, McGraw-Hill.

e-Resources & other digital material

1. https://www.geeksforgeeks.org/engineering-mathematics-tutorials/
2. https://www.tutorialspoint.com/discrete_mathematics/index.htm
3. http://www.alas.matf.bg.ac.rs/~mi10164/Materijali/DS.pdf
4. https://nptel.ac.in/courses/111107058/

Fundamentals of Digital Logic Design

Course Code	20CS3301	**Year**	II	**Semester**	I
Course Category	PCC1	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Basic Electrical & Electronics Engg.
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the basic concepts of digital circuits.	**L2**
CO2	Apply minimization techniques to simplify Boolean expressions.	**L3**
CO3	Apply the principles of digital electronics to design combinational and sequential circuits.	**L3**
CO4	Analyze the functionality of combinational circuits and sequential circuits.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√													
CO2	√									√				
CO3													√	
CO4		√							√	√				

Syllabus		Mapped CO
Unit No	**Contents**	
I	**Digital Systems and Binary Numbers:** Digital Systems, Binary Numbers, Number Base Conversions, Octal and Hexadecimal Numbers, Complements of Numbers, Signed Binary Numbers, Binary codes and Binary Logic.	**CO1**
II	**Boolean Algebra and Logic Gates:** Introduction, Basic Definitions, Axiomatic definition of Boolean Algebra, Basic theorems and properties of Boolean Algebra, Boolean functions, Canonical and Standard Forms. **Gate–Level Minimization**: Introduction, Map Method-Two variable, Three variable K-map‘s, Four Variable K-Map, Product of Sums Simplification, Don‘t Care Conditions, NAND and NOR implementation.	**CO1, CO2**
III	**Combinational Logic:** Introduction, Combinational Circuit, Analysis Procedure, Design Procedure, Binary adder - subtractor, Decimal Adder, BCD to Seven Segment Display, Encoders, Decoder, Multiplexers, Demultiplexers.	**CO1, CO3, CO4**
IV	**Sequential Logic:** Introduction, **Storage Elements:** Latches –SR, D Latches **Storage Elements: Flip Flops**–SR, JK, D and T Flip Flops, Characteristic tables, Characteristic equation, Excitation tables.	**CO1, CO3, CO4**
V	**Registers and Counters:** Registers, **Shift Registers-** Serial Transfer, Serial Addition, Universal Shift Register, **Ripple Counters-**Binary Ripple Counter, BCD Ripple Counter, **Synchronous Counters-**Binary Counter, Up–Down Binary Counter, BCD Counter, Binary Counter with Parallel Load, **Other Counters-** Ring counter, Johnson counter.	**CO1, CO3, CO4**

Learning Resources
Text Books
1. Digital Design, M. Morris Mano, Michael D.Ciletti, Fifth Edition, 2013, Pearson.
References
1. Switching Theory and Finite Automata, Zvi. Kohavi, Niraj K. Jha, Third Edition, 2010, Cambridge, University Press. 2. Fundamentals of Digital circuits, A. Anand Kumar, Third Edition, 2013, PHI.
e-Resources & other digital material
1. https://nptel.ac.in/courses/106/108/106108099/ http://nptel.ac.in/courses/117106086/1 2. https://nptel.ac.in/courses/117/105/117105080/ 3. https://www.udemy.com/course/digital-electronics-logic-design/ 4. https://learnabout-electronics.org/Digital/dig20.php 5. https://www.tutorialspoint.com/digital_circuits/digital_circuits_logic_gates.htm 6. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/

Object Oriented Programming through C++

Course Code	20CS3302	**Year**	II	**Semester**	I
Course Category	PCC2	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Programming for Problem Solving
Continuous Internal Evaluation:	30	**Semester end evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the principles of OOPs and key features of C++	**L2**
CO2	Apply object oriented concepts to develop solution for the given problem.	**L3**
CO3	Apply functions as per the problem requirement.	**L3**
CO4	Analyze the given scenario and choose appropriate generic programming aspects/ exception handling mechanism to solve the problem.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√													
CO2	√									√				
CO3												√	√	
CO4		√							√	√		√		

Syllabus		**Mapped CO**
Unit No.	**Contents**	
I	**Introduction:** Difference between C and C++, Evolution of C++, Programming Paradigms, Key concepts of OOP, Advantages of OOP, Usage of OOP. **I/O in C++:** Pre-defined streams, stream classes, Scope access operator, Name space, memory management operators. **Functions:** Introduction, Parts of a function, Passing arguments, Return by reference, Returning more values by reference, Default arguments, const arguments, Inline functions, Function overloading.	**CO1, CO3**

II	**Classes and Objects :** classes in C++, Declaring objects, Access specifiers and their scope, Defining Member Functions, Characteristics of member functions, Outside member function as inline, rules for Inline functions, static member variables, static member functions, static objects, object as function arguments, Friend Function. **Constructors and Destructors:** Constructors and Destructors, characteristics of constructors and destructors, Applications with constructors, Parameterized constructors, Multiple constructors, copy constructors, destructors, calling constructors and destructors. **Operator Overloading:** The keyword operator, Overloading Unary Operators, Overloading binary operators, Rules for Overloading operators, Overloading Friend function.	**CO1, CO2, CO3**
III	**Inheritance:** Access specifiers and simple inheritance, protected data with private inheritance, Types of Inheritance: Single, Multilevel, Multiple, Hierarchical, Hybrid and Multipath, Virtual Base Classes. **Pointers:** void pointer, wild pointer, The this pointer. **Binding, Polymorphism, and Virtual Functions:** Binding in C++, Pointer to Base and Derived class, Virtual Function, Rules for Virtual functions, Pure Virtual Functions, Abstract Class.	**CO1, CO2, CO3**
IV	**Files**: Introduction, File stream classes, Steps for file operations, Checking for errors, Finding end of file, File opening modes, File pointers and manipulators. **Exception Handling:** Principles of Exception Handling, The Keywords try, throw and catch, Guidelines for Exception Handling, Multiple catch statements, Catching Multiple Exceptions, Re-Throwing Exceptions, Specifying Exceptions.	**CO1, CO2, CO3, CO4**
V	**Generic Programming with Templates:** Need for Templates, Definition of class Templates, Function Template, Working of Function Templates, Class Template with more parameters, Function Template with more parameters. **Standard Template Library:** Introduction to STL, STL Programming model, containers, sequence container: vector, list; Associative containers: set, map; Algorithms: sort, search, find; Iterators.	**CO1, CO2, CO3, CO4**

Learning Resources

Text Books

1. Programming in C++, Ashok N. Kamthane, Second Edition, 2013, Pearson.

References

1. The C++ Programming Language, BjarneStroustup, Fourth Edition, 2013, Addison-Wesley.
2. Object-Oriented Programming Using C++ Paperback, Joyce Farrell, Fourth Edition, 2013, Cengage.

e-Resources and other Digital Material

1. ttps://www.learncpp.com/
2. https://onlinecourses.nptel.ac.in/noc21_cs02/preview
3. https://www.educative.io/courses/learn-object-oriented-programming-in-cpp
4. https://www.youtube.com/watch?v=wN0x9eZLix4 (Learn Object Oriented Programming in C++, Beau Carnes, February 2021)
5. https://www.geeksforgeeks.org/the-c-standard-template-library-stl/

Computer Organization and Architecture

Course Code	20CS3303	**Year**	II	**Semester**	I
Course Category	PCC3	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	-
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the basic functional units of a computer system and its organization.	**L2**
CO2	Apply appropriate instructions for processing various types of computer operations.	**L3**
CO3	Apply various types of organizations on registers.	**L3**
CO4	Analyze memory hierarchy, I/O communication and pipelining.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√													
CO2									√	√			√	
CO3									√	√			√	
CO4		√							√	√				

Syllabus		
Unit No	**Contents**	**Mapped CO**
I	**Register Transfer and Micro-Operations:** Register Transfer Language, Register Transfer, memory Transfers, Bus construction with Multiplexers, Arithmetic Micro-operations, Logic Micro-operations, Shift Micro-operations, Arithmetic Logic Shift Unit.	**CO1,CO2**
II	**Basic Computer Organization:** Instruction codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory-Reference Instructions, Input- Output and Interrupt.	**CO1,CO2**
III	**Central Processing Unit:** General registers Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control.	**CO1,CO3**
IV	**Computer Arithmetic:** Introduction, Addition and Subtraction, Booth Multiplication Algorithm. **Memory Organization:** Memory Hierarchy, Main Memory, Auxiliary memory, Associative Memory, Cache Memory, Virtual Memory.	**CO1,CO2, CO4**
V	**Input-Output Organization:** Peripheral Devices, Input-output Interface, Asynchronous Data Transfer, Priority Interrupt, Direct Memory Access (DMA), Input-Output Processor. **Pipeline and Parallel Processing:** Parallel processing, Pipelining, Arithmetic pipeline, Instruction pipeline.	**CO1,CO4**

Learning Resources
Text Books
1. Computer System Architecture, Morris M. Mano, Third Edition, 1992, Pearson.
References
1. Computer Organization and Architecture, William Stallings, Eighth Edition, 2010, PHI. 2. Computer Organization, Carl Hamachar, Vranesic, 2002, McGraw Hill.
e- Resources and other Digital Material
1. https://nptel.ac.in/courses/106/106/106106092/

Data Structures

Course Code	20ES1305	**Year**	II	**Semester**	I
Course Category	ES	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Programming for Problem Solving
Continuous Internal Evaluation:	30	**Semester end evaluation**	70	**Total Marks**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the basic concepts of algorithm complexities, recursion and data structures.	**L2**
CO2	Apply suitable searching, sorting algorithms for various applications.	**L3**
CO3	Apply suitable data structure to solve the problems.	**L3**
CO4	Analyze the problem to construct an algorithm using suitable data structure.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√													
CO2	√									√				
CO3												√	√	
CO4		√							√	√				

Syllabus		
Unit No	**Contents**	**Mapped CO**
I	**Introduction:** Algorithm Specification, Time complexity & space complexity and their notations. **Recursion:** What is Recursion, Why Recursion, Format of a Recursive function, Recursion and memory, Recursion Vs. Iteration, Examples **Sorting and Searching:** Searching- Linear and Binary search algorithms, Sorting- Bubble, Insertion, Selection, Merge, Quick sort algorithms.	**CO1,CO2**
II	**Linked lists:** Single linked list, double linked list, circular linked list, and operations on linked lists.	**CO1,CO3,CO4**
III	**Stacks:** Definition, operations: array implementation, linked list implementation and applications. **Queues:** Definition, operations: array implementation, linked list implementation and applications, Circular Queue.	**CO1,CO3,CO4**
IV	**Trees:** Introduction- Terminology, representation of trees, binary trees abstract data type, Properties of binary trees, binary tree representation, binary tree traversals In order, preorder, post order, Binary search trees Definition, searching BST, insert into BST, delete from a BST, Height of a BST.	**CO1,CO3,CO4**
V	**Graphs:** The Graph ADT Introduction, definition, graph representation, elementary graph operations BFS, DFS, Minimum Spanning Tree – only: Prim‘s and Kruskal‘s MST.	**CO1,CO3,CO4**

Learning Resources

Text Books

1. Data Structures and Algorithm Analysis in C, Mark Allen Weiss, Second Edition, 2002, Pearson.
2. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Third Edition, 2010, PHI.
3. Data Structures and Algorithms Made Easy by Narasimha Karumanchi, 2020, CareerMonk Publications.

References

1. Fundamental of Data Structures in C, Horowitz, Sahani, Anderson-Freed, Second Edition, 2008, Universities Press.
2. Classic Data Structures, Debasis Samantha, Second Edition, 2009, PHI.

e-Resources & other digital material

1. http://cse.iitkgp.ac.in/pds/
2. http://cmpe.emu.edu.tr/bayram/courses/231/LectureNotesSlides/IQBAL/Lecture%20Notes
3. https://www.geeksforgeeks.org/data-structures/
4. https://www.programiz.com/dsa
5. https://www.tutorialspoint.com/data_structures_algorithms/index.htm
6. https://www.youtube.com/watch?v=zWg7U0OEAoE&list=PLBF3763AF2E1C572F
7. https://www.youtube.com/watch?v=S47aSEqm_0I&list=PLgj_V-ZKxRKrxgFyOutPJpoLFBaQMOpK-

Object Oriented Programming through C++ Lab

Course Code	20CS3351	**Year**	II	**Semester**	I
Course Category	PCC Lab	**Branch**	CSE	**Course Type**	Practical
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Programming for Problem Solving
Continuous Internal Evaluation:	15	**Semester end evaluation**	35	**Total Marks**	50

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Apply Object oriented principles/ C++ constructs for solving problems.	**L3**
CO2	Implement programs as an individual on different IDEs/ online platforms.	**L3**
CO3	Develop an effective report based on various programs implemented.	**L3**
CO4	Apply technical knowledge for a given problem and express with an effective oral communication.	**L3**
CO5	Analyze outputs using given constraints/test cases.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1													√	
CO2					√				√					
CO3										√				
CO4	√									√				
CO5			√											

Syllabus		
Expt No.	**Contents**	**Mapped CO**
1	Implement programs on predefined streams.	**CO1,CO2,CO3,CO4,CO5**
2	Implement programs using functions (passing arguments, overloading).	**CO1,CO2,CO3,CO4,CO5**
3	Implement programs using class/object concepts. (Access specifiers, class members, static members)	**CO1,CO2,CO3,CO4,CO5**
4	Implement programs using friend functions.	**CO1,CO2,CO3,CO4,CO5**
5	Implement programs using constructor(s) and destructor.	**CO1,CO2,CO3,CO4,CO5**
6	Implement programs using operator overloading.	**CO1,CO2,CO3,CO4,CO5**
7	Implement various types of inheritance techniques.	**CO1,CO2,CO3,CO4,CO5**
8	Implement programs using virtual functions to achieve polymorphism.	**CO1,CO2,CO3,CO4,CO5**
9	Implement programs using FileStreams	**CO1,CO2,CO3,CO4,CO5**
10	Implement programs on exception handling concepts.	**CO1,CO2,CO3,CO4,CO5**
11	Implement programs on generic programming concept with templates.	**CO1,CO2,CO3,CO4,CO5**
12	Implement containers in C++ (Sequence Containers and Associative Containers).	**CO1,CO2,CO3,CO4,CO5**

Learning Resources

Text Books

1. Object-Oriented Programming in C++, Robert Lafore, Fourt Edition, 2002, SAMS.
2. Object-Oriented Programming with C++, E Balagurusamy, Eigth Edition, 2020, Mc Graw Hill.

References

1. The C++ Programming Language, Bjarne Stroustup, Fourth Edition, 2013, Addison-Wesley.
2. Object-Oriented Programming Using C++ Paperback, Joyce Farrell, Fourth Edition, 2013, Cengage.

e-Resources and other Digital Material

1. https://www.learncpp.com/
2. https://onlinecourses.nptel.ac.in/noc21_cs02/preview
3. https://www.educative.io/courses/learn-object-oriented-programming-in-cpp
4. https://www.youtube.com/watch?v=wN0x9eZLix4 (Learn Object Oriented Programming in C++, Beau Carnes, February 2021)

Data Structures Lab

Course Code	20ES1356	**Year**	II	**Semester**	I
Course Category	ES Lab	**Branch**	CSE	**Course Type**	Practical
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Programming for Problem Solving
Continuous Internal Evaluation:	15	**Semester end evaluation**	35	**Total Marks**	50

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Apply Linear and non-linear data structures for solving problems.	**L3**
CO2	Implement programs as an individual on different IDEs	**L3**
CO3	Develop an effective report based on various programs implemented	**L3**
CO4	Apply technical knowledge for a given problem and express with an effective oral communication	**L3**
CO5	Analyze outputs using given constraints/test cases	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1														√
CO2					√				√					
CO3										√				
CO4	√									√				
CO5			√											

Syllabus		Mapped CO
Unit No.	**Contents**	**Mapped CO**
1.	Demonstrate recursive algorithms with examples.	**CO1,CO2,CO3,CO4,CO5**
2.	Implement various searching techniques.	**CO1,CO2,CO3,CO4,CO5**
3.	Develop programs for different sorting techniques	**CO1,CO2,CO3,CO4,CO5**
4.	Implement and perform different operations on Single, Double and Circular Linked Lists.	**CO1,CO2,CO3,CO4,CO5**
5.	Develop a program to perform operations of a Stack using arrays and linked Lists.	**CO1,CO2,CO3,CO4,CO5**
6.	Develop programs to implement Stack applications.	**CO1,CO2,CO3,CO4,CO5**
7.	Develop a program to perform operations of Linear Queue using arrays and linked Lists.	**CO1,CO2,CO3,CO4,CO5**
8.	Implement Circular Queues.	**CO1,CO2,CO3,CO4,CO5**
9.	Develop a program to represent a tree data structure.	**CO1,CO2,CO3,CO4,CO5**
10.	Develop a program to demonstrate operations on Binary Search Tree.	**CO1,CO2,CO3,CO4,CO5**
11.	Demonstrate Graph Traversal Techniques.	**CO1,CO2,CO3,CO4,CO5**
12.	Develop a program to find Minimum cost Spanning tree.	**CO1,CO2,CO3,CO4,CO5**

Learning Resources

Text Books

1. Data Structures and Algorithm Analysis in C, Mark Allen Weiss, Second Edition, 2002, Pearson.
2. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Third Edition, 2010, PHI.
3. Data Structures and Algorithms Made Easy by Narasimha Karumanchi, 2020, CareerMonk Publications.

e-Resources & other digital material

1. https://www.cs.usfca.edu/~galles/visualization/Algorithms.html
2. http://www.algomation.com/algorithm/single-linked-list-insert-delete
3. http://www.algomation.com/algorithm/binary-tree-insert-delete-display
4. https://www.youtube.com/watch?v=AfYqN3fGapc
5. https://www.youtube.com/watch?v=7vw2iIdqHlM
6. http://littlesvr.ca/dsa-html5-animations/sorting.php

Python Programming

Course Code	20CS3352	**Year**	II	**Semester**	I
Course Category	PCC Lab	**Branch**	CSE	**Course Type**	Practical
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Programming for Problem Solving
Continuous Internal Evaluation :	15	**Semester End Evaluation:**	35	**Total Marks:**	50

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Apply Python programming constructs for solving problems.	**L3**
CO2	Conduct experiments as an individual, or team member by using Python programming.	**L3**
CO3	Develop an effective report based on various programs implemented.	**L3**
CO4	Apply technical knowledge for a given problem and express with an effective oral communication.	**L3**
CO5	Analyze outputs generated through Python programming.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													√	
CO2					√				√					
CO3										√				
CO4	√									√				
CO5			√											

Syllabus		
Expt No	**Contents**	**Mapped CO**
1.	Demonstrate the difference between interactive mode and IDEs	**CO1,CO2,CO3,CO4,CO5**
2.	Demonstrate programs using basic constructs of Python.	**CO1,CO2,CO3,CO4,CO5**
3.	Programs to demonstrate Programming constructs.	**CO1,CO2,CO3,CO4,CO5**
4.	Programs to demonstrate decision making and branching (Selection)	**CO1,CO2,CO3,CO4,CO5**
5.	Programs to demonstrate iterative statements.	**CO1,CO2,CO3,CO4,CO5**
6.	Build modular programs using functions.	**CO1,CO2,CO3,CO4,CO5**
7.	Programs to perform operations on strings, regular expressions with built – in functions.	**CO1,CO2,CO3,CO4,CO5**
8.	Implement programs using various data structures.	**CO1,CO2,CO3,CO4,CO5**
9.	Programs to demonstrate access specifiers.	**CO1,CO2,CO3,CO4,CO5**
10.	Programs to demonstrate types of Inheritance, polymorphism,	**CO1,CO2,CO3,CO4,CO5**
11.	Python programming to demonstrate Exception handling	**CO1,CO2,CO3,CO4,CO5**
12	Installing, importing accessing and computations on a dataset using Pandas library.	**CO1,CO2,CO3,CO4,CO5**
13	Installing, importing accessing and computations on a dataset using Numpy library.	**CO1,CO2,CO3,CO4,CO5**
14	Programs to demonstrate Files.	**CO1,CO2,CO3,CO4,CO5**
15	Installing, importing accessing and computations on a dataset using MatplotLib library	**CO1,CO2,CO3,CO4,CO5**

Learning Resources

Text Books

1. Python Programming using Problem Solving Approach, Reema Thareja, 2017, OXFORD University Press
2. Charles Severance: Python for Everybody, Exploring Data in Python 3, Creative Commons-2016
3. Jake VanderPlas: Python Data Science Handbook, Essential Tools for Working with Data, O'Reilly Media, 2016
4. Python Programming: Problem Solving, Packages and Libraries, Anurag Gupta and G.P. Biswas,2020, McGraw Hill

Reference Books

1. Core Python programming, R. NageswaraRao, 2018, Dreamtech press.
2. Programming with python, T R Padmanabhan, 2017, Springer.
3. Edouard Duchesnay: Statistics and Machine Learning in Python Release 0.2, 2018
4. Wes McKinney: Python for Data Analysis, Agile Tools for Real World Data, O'Reilly Media, 2013

Resources & other digital material

1. NPTEL Course: Programming, Data Structures and Algorithms using Python, Registration Link: https://nptel.ac.in/courses/106/106/106106145/
2. Coursera: Introduction to Python Programming, Registration link: https://www.coursera.org/learn/python-programming-intro

Introduction to Linux Operating System

Course Code	20SO8355	**Year**	II	**Semester**	I
Course Category	SOC-1	**Branch**	CSE	**Course Type**	Practical
Credits	2	**L-T-P**	1-0-2	**Prerequisites**	-
Continuous Internal Evaluation :	-	**Semester End Evaluation:**	50	**Total Marks:**	50

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Apply suitable commands to perform various tasks on Linux Operating System.	**L3**
CO2	Implement tasks as an individual on Linux Operating System.	**L3**
CO3	Develop an effective report based on various tasks implemented.	**L3**
CO4	Apply technical knowledge for a given problem and express with an effective oral communication.	**L3**
CO5	Analyze outputs using given constraints.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		√											√	
CO2					√				√					
CO3										√				
CO4									√		√			
CO5			√			√								

Syllabus		
Unit No.	**Contents**	**Mapped CO**
1	Accessing the Command Line.	**CO1,CO2,CO3,CO4,CO5**
2	Managing Files from the Command Line.	**CO1,CO2,CO3,CO4,CO5**
3	Creating, Viewing and Editing Text Files.	**CO1,CO2,CO3,CO4,CO5**
4	Archiving and Copying Files Between Systems.	**CO1,CO2,CO3,CO4,CO5**
5	Manage users and groups.	**CO1,CO2,CO3,CO4,CO5**
6	Controlling Access to Files with Linux File System Permissions.	**CO1,CO2,CO3,CO4,CO5**
7	Manage basic networking.	**CO1,CO2,CO3,CO4,CO5**
8	Installing and Updating Software Packages.	**CO1,CO2,CO3,CO4,CO5**

Learning Resources
Text Books
1. Red Hat Enterprise Linux 8.0 RH124, Red Hat System Administration I, Edition 1, Fiona Allen, Marc Kesler, Saumik Paul, Snehangshu Karmakar, Victor Costea
References
1. https://www.coursera.org/learn/fundamentals-of-red-hat-enterprise-linux 2. https://www.udemy.com/course/certified-system-administrator/
e-Resources & Other Digital Material
1. https://www.redhat.com/en/services/training/ex200-red-hat-certified-system-administrator-rhcsa-exam

Environmental Sciences

Course Code	20MC1301	**Year**	II	**Semester**	I
Course Category	MC	**Branch**	CSE	**Course Type**	Theory
Credits	0	**L-T-P**	3-0-0	**Prerequisites**	**-**
Continuous Internal Evaluation :	100	**Semester End Evaluation:**	-	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Apply advanced solutions to measure the threats and hazards in environment to link with human natural systems	**L3**
CO2	Analyze the ethical, cultural and historical interactions between man and environment.	**L4**
CO3	Analyze various environmental assets and record for better management.	**L4**
CO4	Analyze global issues to design and evaluate policies	**L4**
CO5	Apply system concepts to methodological social and environmental issues.	**L3**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√						√							√
CO2		√					√							√
CO3		√					√							√
CO4		√					√							√
CO5	√						√							√

Syllabus		
UNIT NO.	**Contents**	**Mapped CO**
I	**Introduction To Environment And Natural Resources** Introduction to environment: Definition scope importance need for public awareness. Natural resources: Renewable and nonrenewable resources, natural resources and associated problems. Forest resources: Uses, Reasons for over-exploitation, deforestation effects case studies. Water resources: Use and over – utilization of surface and ground water, floods, drought, conflicts over water, dams- benefits and problems. Mineral resources: Uses, environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, Impacts of overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: Growing energy needs, use of renewable and nonrenewable energy sources, case studies.	**CO1**
II	**Ecosystems And Biodiversity** Structure components of ecosystem: Biotic and Abiotic components. Functional components of an ecosystem: Food chains, Food webs, Ecological pyramids, Energy flow in the ecosystem, Ecological succession. Biogeochemical cycle: Nitrogen, carbon, Phosphorus cycle. Biodiversity: Definition, Levels of biodiversity: genetic, species and ecosystem diversity. Bio-geographical classification of India, Values of biodiversity: consumptive use, productive use, social, ethical, aesthetic and optional values. 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.	**CO2**
III	**Environmental Pollution And Control** Environmental Pollution: Definition, causes, effects and control measures: Air Pollution, Water pollution, Soil pollution, Marine pollution, Thermal pollution, Nuclear hazards, Solid waste Management, e-waste, Pollution case studies.	**CO3**
IV	**Social Issues And Global Environment Problems And Efforts** From Unsustainable to Sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management, and Remote sensing and GIS methods. Environmental ethics: Issues and possible solutions. Green building concept, Environmental Impact Assessment Environmental Management Plan, Climate change: global warming, acid rain, ozone layer depletion.	**CO4**
V	**Human Population And Environment Legislation** Population growth, Environment and human health. HIV/AIDS, Value Education. Women and Child Welfare. Role of Information Technology in Environment and human health. Environment Legislation. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Environmental Protection Act.	**CO5**

Learning Resources
Text Books
1. Environmental studies, Anubha Kaushik and C.P. Kaushik, 2014, New Age International Publishers. 2. Text book of environmental studies for undergraduates courses, Erach Barucha, University Grants Commission, 2005, University Press. 3. Environmental Studies, Anindita Basak, 2009, Pearson.
Reference Books
1. A Text book of Environmental Studies, D.K. Asthana and Meera Asthana, 2010, S. Chand. 2. Solid and Hazardous waste Management, P.M Cherry, 2016, CBS Publisher. 3. Environmental Impact Assessment, Charles H. Ecclestion, 2011, CRC Press.

Community Service Project

Course Code	20CS3391	**Year**	II	**Semester**	I
Course Category		**Branch**	CSE	**Course Type**	Proj
Credits	4	**L-T-P**	0-0-0	**Prerequisites**	-
Continuous Evaluation :	-	**Semester End Evaluation:**	100	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Analyze the issues that confront the vulnerable/marginalized section of society (village/community/habitation) and identify problem (s), objectives, requirements, and scope with proper planning in compilation of community service project.	**L4**
CO2	Apply the engineering knowledge in project design and use methods to carry out the project work by justifying ethical principles.	**L3**
CO3	Create an economic ecosystem using modern tools to meet societal needs and examine the results obtained to derive conclusions.	**L6**
CO4	Evaluate the performance of the project task as an individual and / or team members based on their effective communication, presentation, and report to manage the task in time.	**L5**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO1 2**	**PSO 1**	**PSO 2**
CO1	√	√											√	√
CO2			√	√				√				√		
CO3					√	√	√						√	√
CO4									√	√	√			

Formal Languages and Automata Theory

Course Code	20BS1403	**Year**	II	**Semester**	II
Course Category	BS	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Discrete Mathematical Structures
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the fundamental concepts of Formal Languages and Automata.	**L2**
CO2	Apply the knowledge of Automata Theory, Grammars & Regular Expressions for solving various problems.	**L3**
CO3	Apply different Turing machines techniques to solve problems.	**L3**
CO4	Analyze automata and their computational power to recognize languages.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√													
CO2	√									√				
CO3													√	
CO4		√							√	√		√		

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Automata:** Why study Automata Theory?, The central Concepts of Automata Theory. **Finite Automata:** Deterministic Finite Automata, Non-Deterministic Finite Automata, Finite Automata with Epsilon Transitions, Finite Automata with Outputs(without conversions)	**CO1, CO2, CO4**

II	**Regular Expressions and Languages**: Regular Expressions, Finite Automata and Regular Expressions, Algebraic Laws for Regular expressions (without proofs). **Properties of regular Languages:** Proving Languages not to be regular, Closure properties of Regular Languages (without proofs), Equivalence and Minimization of Automata.	**CO1, CO2**
III	**Context–free grammars and Languages**: Context–free grammars, Parse trees, Ambiguity in grammars and Languages, **Properties of Context-free languages:** Normal Forms for Context Free Grammars, The Pumping Lemma For Context Free Languages	**CO1, CO2**
IV	**Pushdown Automata:** Definition of the Pushdown Automaton, The Languages of a PDA, Equivalence of PDA‘s and CFG‘s, Deterministic Pushdown Automaton.	**CO1, CO2, CO4**
V	**Turing Machines:** Problems that computer cannot solve, The Turing Machine, Programming Techniques for Turing Machine, Extensions to the Basic Turing Machine **Undecidability:** Recursively Enumerable Language, Universal Turing Machines (UTM), Halting Problem, Post Correspondence Problem, Church Hypothesis.	**CO1,CO2, CO3, CO4**

Learning Resources

Text Books

1. Introduction to Automata Theory, Languages and Computations, J.E.Hopcroft, R.Motwani and J.D Ullman, Third Edition, Pearson Education.
2. Theory of Computer Science, Automata languages and computation, Mishra, Chandra Shekaran, Second Edition, PHI.

Reference Books

1. Introduction of the Theory and Computation, Michael Sipser, 1997, Thomson Brokecole.
2. Elements of The theory of Computation, H.R.Lewis and C.H.Papadimitriou, Second Edition, 2003, Pearson Education/PHI.
3. Formal Languages and Automata Theory, Basavarj S. Anami, Karibasappa K.G, WILEYINDIA.
4. Introduction to Languages and the Theory of Computation, J.C.Martin, Third Edition, TMH, 2003.

e- Resources & other digital material

1. https://www.udemy.com/course/formal-languages-and-automata-theory-e/
2. https://eecs.wsu.edu/~ananth/CptS317/
3. https://nptel.ac.in/courses/106/103/106103070/
4. https://nptel.ac.in/courses/106/106/106106049/
5. https://nptel.ac.in/courses/111/103/111103016/
6. https://nptel.ac.in/courses/106/105/106105196/

Operating Systems

Course Code	20CS3401	**Year**	II	**Semester**	II
Course Category	PCC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Data structures, Computer Organization and Architecture
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the structure and functionalities of operating systems	**L2**
CO2	Apply different algorithms of CPU scheduling, Page replacement and disk scheduling	**L3**
CO3	Apply various concepts to solve problems related to process synchronization and deadlocks.	**L3**
CO4	Analyze and interpret the functionalities of operating system.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√													
CO2	√													
CO3													√	
CO4		√							√	√				

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Overview: Introduction**: What Operating Systems Do, Computer-System Organization, Computer-System Architecture, Operating-System Structure, Operating-System Operations **Operating System Structures:**	**CO1,CO2,CO3**

	Operating-System Services, User and Operating-System Interface, System Calls, Types of System Calls.	
II	**Process Management:** Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication. **Threads:** Overview, Multi-core Programming, Multithreading Models. **Process Scheduling:** Basic Concepts, Scheduling Criteria, Scheduling Algorithms (First-Come, First-Served Scheduling, Shortest-Job-First Scheduling, Priority Scheduling, Round-Robin Scheduling.)	**CO1,CO2,CO4**
III	**Process Synchronization:** Background, The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic Problems of Synchronization, Monitors. **Deadlocks:** System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.	**CO1, CO3,CO4**
IV	**Memory Management:** **Main Memory:** Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table **Virtual Memory:** Background, Demand Paging, Copy-on-Write, Page Replacement, Basic Page Replacement, FIFO Page Replacement, Optimal Page Replacement, LRU Page Replacement, LRU-Approximation Page Replacement, Allocation of Frames, Thrashing.	**CO1, CO2,CO4**
V	**Storage Management:** **File–System Interface:** File Concept, Access Methods, Directory and Disk Structure. **File–System Implementation:** File-System Structure, File- System Implementation, Directory Implementation, Allocation Methods. **Mass-Storage Structure**: Overview of Mass-Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, FCFS Scheduling, SSTF Scheduling, SCAN Scheduling, C-SCAN Scheduling, LOOK Scheduling, Selection of a Disk-Scheduling Algorithm.	**CO1, CO2,CO4**

Learning Resources

Text book

1. Operating System Concepts, Abraham Silberchatz, Peter Baer Galvin, Greg Gagne, Ninth Edition, 2016, Wiley India.

References

1. Operating Systems - Internal and Design Principles, William Stallings, Ninth Edition, 2018, Pearson.
2. Operating Systems - Harvey M.Deitel, Paul J Deitel and David R.Choffnes , Third Edition, 2019, Pearson.
3. Operating Systems - A Concept based Approach- D.M. Dhamdhere, Second Edition, 2010, McGraw Hill.

e-Resources and other Digital Material

1. https://onlinecourses.nptel.ac.in/noc19_cs50/
2. http://www.youtube.com/watch?v=MaA0vFKtew&list=PL88oxI15Wi4Kw1aEY2bC5l_4pouojjtd4

Advanced Data Structures

Course Code	20CS3402	**Year**	II	**Semester**	II
Course Category	PCC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Data Structures
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the basic principles and operations of data structures.	**L2**
CO2	Apply Hashing and String Matching techniques for solving problems effectively.	**L3**
CO3	Apply the concepts of advanced Trees and Graphs for solving problems effectively.	**L3**
CO4	Analyze the given scenario and choose appropriate Data Structure for solving problems.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO**
CO1	√													
CO2	√								√	√		√	√	√
CO3	√								√	√		√	√	√
CO4		√							√	√		√		√

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Hashing** – General Idea, Hash Function, Separate Chaining, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Universal Hashing, Extendible Hashing. **Skip Lists:** Skip list representation, Search and Update Operations on skip lists.	**CO1,CO2**
II	**Priority Queues (Heaps)** – Introduction, Binary Heaps, Basic Heap Operations, Binomial Heaps/Queues, Binomial Queue Structure, Binomial Queue Operations. Implementation of Binomial Heaps.	**CO1,CO3**
III	**Efficient Binary Search Trees** – AVL Trees, Single rotation, Double rotation, Splay Trees, Red-Black Trees, B-Trees: Definition of B-trees, Basic operations on B-trees, Deleting a key from a B-tree. 2-3 Trees.	**CO1,CO3**
IV	**The Disjoint Sets Class** – Equivalence relation, Basic Data Structure, Union and Find algorithms, Smart Union and Path compression algorithm. **Graphs Algorithms** – Elementary Graph Operations: Topological sort, Single Source Shortest Path Algorithms: Dijkstra's, Bellman-Ford, All-Pairs Shortest Paths: Floyd-Warshall's Algorithm. Network Flow Problems: A simple Maximum flow algorithm.	**CO1,CO3,CO4**
V	**String Matching** – The naive string-matching algorithm, The Rabin-Karp algorithm, The Knuth-Morris-Pratt algorithm. **Digital Search Structures** – Operations on search trees: Insertion, Searching, Deletion. Binary Tries and Patricia: Binary Tries, Compressed Binary Trie, Patricia: searching, insertion, deletion.	**CO1,CO2,CO4**

Learning Resources

Text Books

1. Data Structures and Algorithm Analysis in C++, Mark Allen Weiss, Fourth Edition, 2014, Pearson.
2. Introduction to Algorithms, Thomas H Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Third Edition, 2009, The MIT Press.

References

1. Advanced Data Structures, Reema Thareja, S. Rama Sree, Oxford University Press, 2018.
2. Data Structures and Algorithms Made Easy by Narasimha Karumanchi, 2020, CareerMonk Publications.
3. Advanced Data Structures, Peter Brass, Cambridge University Press, 2008.

e-Resources and other Digital Material

1. https://www.youtube.com/watch?v=T0yzrZL1py0&list=PLUl4u3cNGP61hsJNdULdudlRL493b-XZf (MITOPENSOURCEWARE)
2. http://ocw.mit.edu/6-851S12
3. https://nptel.ac.in/courses/106/106/106106133/
4. https://www.mooc-list.com/search/node?keys=Advanced+Data+Structures
5. http://freevideolectures.com/Course/2279/Data-Structures-And-Algorithms

Design and Analysis of Algorithms

Course Code	20CS3403	**Year**	II	**Semester**	II
Course Category	PCC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Discrete Mathematical Structures and Data Structures
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the fundamental concepts of algorithm analysis and design techniques.	**L2**
CO2	Apply various algorithm design techniques for solving problems	**L3**
CO3	Analyze the performance of given problem using different algorithm techniques.	**L4**
CO4	Analyze the given problem and provide the feasible solution.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√													
CO2	√													
CO3		√												
CO4		√							√	√		√		

Syllabus		
Unit No	**Contents**	**Mapped CO**
I	**Introduction**: Notion of Algorithm, Fundamentals of Algorithmic Problem Solving. Fundamentals of the Analysis of Algorithm Efficiency: Analysis framework and Asymptotic Notations and Basic Efficiency Classes, Amortized Analysis. Introduction to Brute Force Technique, Exhaustive Search.	**CO1,CO2,CO3**
II	**Divide and Conquer:** Introduction, Merge sort, Quick sort, Binary Search, Finding Maximum and Minimum, Strassen‘s Matrix Multiplication.	**CO1,CO2,CO3,CO4**
III	**The Greedy Method:** Introduction, Huffman Trees and codes, Minimum Coin Change problem, Knapsack problem, Job sequencing with deadlines, Minimum Cost Spanning Trees, Single Source Shortest paths.	**CO1,CO2,CO3,CO4**
IV	**Dynamic Programming**: Introduction, 0/1 Knapsack problem, All pairs shortest paths, Optimal Binary search trees, Travelling salesman problem.	**CO1,CO2,CO3,CO4**
V	**Back Tracking:** Introduction, n-Queens problem, Sum of subsets, Hamiltonian cycle. **Branch and Bound:** Introduction, Assignment problem, Travelling Salesman problem. **Introduction to Complexity classes**: P and NP Problems, NP-Complete Problems.	**CO1,CO2,CO3,CO4**

Learning Resources

Text Books

1. Introduction to the Design & Analysis of Algorithms, Anany Levitin, Third Edition, 2011, Pearson Education.
2. Data Structures and Algorithm Analysis in C, Mark Allen Weiss, 2002, Pearson.
3. Algorithm Design Techniques, Narasimha Karumanchi, CareerMonk Publications, 2018.

References

1. Introduction to Algorithms, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Third Edition, 2012, MIT Press.
2. Fundamentals of computer algorithms, Ellis Horowitz, Sartaj Sahni, S. Rajasekharan, Second Edition, 2008, Universities Press.

e-Resources and other Digital Material

1. https://nptel.ac.in/courses/106/106/106106131/
2. https://www.cmi.ac.in/~madhavan/
3. https://www.coursera.org/lecture/analysis-of-algorithms/resources-jMWPy
4. https://www.geeksforgeeks.org/fundamentals-of-algorithms/

Internet of Things

Course Code	20ES1402	**Year**	II	**Semester**	II
Course Category	ES	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	-
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Summarize the genesis and impact of IoT applications, architectures in real world.	**L2**
CO2	Apply diverse methods in deploying smart objects and connecting them to network.	**L3**
CO3	Construct simple applications using Arduino.	**L3**
CO4	Analyze different protocols and select which protocol can be used for a specific application.	**L4**
CO5	Identify and develop a solution for a given application using APIs.	**L3**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√											√	√	√
CO2	√				√								√	√
CO3	√				√								√	√
CO4		√											√	√
CO5	√				√								√	√

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	Genesis of IoT, IoT and Digitization, IoT Impact-Connected roadways, Smart connected buildings, Convergence of IT and IoT, IoT Challenges, Comparing IoT Architectures - OneM2M IoT Architecture and IoTWF Architecture, A Simplified IoT Architecture.	**CO1, CO2**
II	Smart Objects: The Things in IoT- Sensors, Actuators, and Smart Objects, Sensor Networks-Advantages and Disadvantages, Communications Criteria-Range, Frequency bands, Power consumption, Topology, IoT Access Technologies- IEEE 802.15.4,IEEE 1901.2a,IEEE 802.11ah (only Standardization and Alliances, Physical Layer, MAC Layer and Topology)	**CO1, CO2**
III	Embedded Computing Basics- Microcontrollers, System-on-Chips, Choosing Your Platform, Arduino- Developing on the Arduino, Some Notes on the Hardware, Openness	**CO1, CO3**
IV	Communication in the IoT: Internet Principles, Internet Communications: An Overview- IP, TCP, The IP Protocol Suite (TCP/IP), UDP, IP Addresses- DNS, Static IP Address Assignment, Dynamic IP Address Assignment, IPv6, MAC Addresses, TCP and UDP Ports- An Example: HTTP Ports, Other Common Ports, Application Layer Protocols- HTTP, HTTPS: Encrypted HTTP, Other Application Layer Protocols.	**CO1, CO4**
V	Prototyping Online Components: Getting Started with an API, Writing a New API, Real-Time Reactions, other Protocols.	**CO1, CO5**

Learning Resources

Text Books

1. Adrian McEwen, Hakim Cassimally - Designing the Internet of Thing Wiley Publications, 2012.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,‖IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, 1stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)

Reference Books

1. ArshdeepBahga, Vijay Madisetti - Internet of Things: A Hands-On Approach, Universities Press, 2014
2. Srinivasa K G, Internet of Things,CENGAGE Leaning India, 2017

Internet of Things Lab

Course Code	20ES1452	**Year**	II	**Semester**	II
Course Category	ES Lab	**Branch**	CSE	**Course Type**	Practical
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Programming for Problem Solving
Continuous Internal Evaluation :	15	**Semester End Evaluation:**	35	**Total Marks:**	50

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Develop various sensor interfacing using Arduino IDE	**L3**
CO2	Evaluate Wireless Control of Remote Devices	**L4**
CO3	Design and develop Mobile Application which can interact with Sensors and Actuators.	**L5**
CO4	Make an effective report based on experiments.	**L3**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√				√									√
CO2		√			√									√
CO3			√		√									√
CO4	√								√	√				√

Syllabus		
EXP No.	**Contents**	**Mapped CO**
1	Digital I/O Interface – Blynk LED, Multicolour LED.	**CO1, CO4**
2	Digital I/O Interface - IR Sensor, Slot Sensor	**CO1, CO4**
3	Analog Read and Write - Potentiometer, Led Brightness Control.	**CO1, CO4**
4	Analog Read and Write -Temperature Sensor	**CO1, CO4**
5	Dc Motor Control - Dc Motor Speed and Direction Control.	**CO1, CO4**
6	Serial Communication - Device Control.	**CO1, CO4**
7	Fabrication and direction control of wheeled robot using Arduino	**CO1, CO4**
8	Wireless Module Interface -Wifi.	**CO1, CO2,CO4**
9	Basic Android App Development using MIT App Inventor.	**CO1,CO3, CO4**
10	Smart Home Android App Development using App Inventor and Arduino.	**CO1,CO3, CO4**

Learning Resources

Text Books

1. Sylvia Libow Martinez, Gary S Stager, ―Invent To Learn: Making, Tinkering, and Engineering in the Classroom‖, Constructing Modern Knowledge Press, 2016.

References

1. Michael Margolis, ―Arduino Cookbook‖, Oreilly, 2011.

Advanced Data Structures Lab

Course Code	20CS3451	**Year**	II	**Semester**	II
Course Category	Professional Core Course Lab	**Branch**	CSE	**Course Type**	Practical
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Data Structures, Object Oriented Programming through C++
Continuous Internal Evaluation:	15	**Semester End Evaluation:**	35	**Total Marks:**	50

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Apply Object oriented principles/ C++ constructs for solving problems.	**L3**
CO2	Implement programs as an individual on different IDEs/ online platforms.	**L3**
CO3	Develop an effective report based on various programs implemented.	**L3**
CO4	Apply technical knowledge for a given problem and express with an effective oral communication.	**L3**
CO5	Analyze outputs using given constraints/test cases.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														√
CO2					√				√					
CO3										√				
CO4		√								√				
CO5			√											

SYLLABUS		
Expt. No.	**CONTENTS**	**Mapped CO**
1	a) Implement various Hashing Techniques. b) Develop a solution to the given problem using Hashing Techniques.	**CO1,CO2,CO3,CO4,CO5**
2	a) Implement Binary Heap and its operations. b) Develop a solution to the given problem using Binary Heaps.	**CO1,CO2,CO3,CO4,CO5**
3	a) Implement AVL Trees and its operations. b) Develop a solution to the given problem using AVL Trees.	**CO1,CO2,CO3,CO4,CO5**
5	a) Implement 2-3 Trees and its operations. b) Develop a solution to the given problem using 2-3 Trees.	**CO1,CO2,CO3,CO4,CO5**
6	a) Implement disjoint sets and its operations. b) Develop a solution to the given problem by using Disjoint set.	**CO1,CO2,CO3,CO4,CO5**
7	Develop a solution to the given graph problem by choosing an effective algorithm.	**CO1,CO2,CO3,CO4,CO5**
8	Develop a solution to search for a pattern string using String Search Techniques.	**CO1,CO2,CO3,CO4,CO5**

Learning Resources

Text Books

1. Data Structures and Algorithm Analysis in C++, Mark Allen Weiss, Fourth Edition, 2014, Pearson.
2. Introduction to Algorithms, Thomas H Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Third Edition, 2009, The MIT Press.

References

1. Advanced Data Structures, Reema Thareja, S. Rama Sree, Oxford University Press, 2018.
2. Data Structures and Algorithms Made Easy by Narasimha Karumanchi, 2020, CareerMonk Publications.
3. Advanced Data Structures, Peter Brass, Cambridge University Press, 2008.

e-Resources and other Digital Material

1. https://www.youtube.com/watch?v=T0yzrZL1py0&list=PLUl4u3cNGP61hsJNdULdudlRL493b-XZf (MITOPENSOURCEWARE)
2. http://ocw.mit.edu/6-851S12
3. https://nptel.ac.in/courses/106/106/106106133/
4. https://www.mooc-list.com/search/node?keys=Advanced+Data+Structures

Design and Analysis of Algorithms Lab

Course Code	20CS3452	**Year**	II	**Semester**	II
Course Category	PCC Lab	**Branch**	CSE	**Course Type**	Practical
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Data Structures, Programming for Problem Solving
Continuous Internal Evaluation :	15	**Semester End Evaluation:**	35	**Total Marks:**	50

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Apply different design techniques for solving problems.	**L3**
CO2	Implement programs as an individual on different IDEs/ online platforms.	**L3**
CO3	Develop an effective report based on various programs implemented.	**L3**
CO4	Apply technical knowledge for a given problem and express with an effective oral communication.	**L3**
CO5	Analyze outputs using given constraints/test cases.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√												√	
CO2					√				√					
CO3										√				
CO4	√									√				
CO5			√											

Syllabus		
Expt. No	**Contents**	**Mapped CO**
1.	Develop and implement an algorithm using Divide and Conquer strategy for a given set of problems.	**CO1,CO2,CO3,CO4,CO5**
2.	Make use of Greedy method to implement a solution for a given problem.	**CO1,CO2,CO3,CO4,CO5**
3.	Develop and implement an efficient solution using Dynamic Programming.	**CO1,CO2,CO3,CO4,CO5**
4.	Use Backtracking design technique to implement a solution for a given problem.	**CO1,CO2,CO3,CO4,CO5**
5.	Develop and implement an algorithm using Branch and Bound technique for solving a given problem.	**CO1,CO2,CO3,CO4,CO5**
6.	**Case Study-1:** Apply the most appropriate design technique to develop and implement an efficient solution for a given problem.	**CO1,CO2,CO3,CO4,CO5**
7.	**Case Study-2:** Develop and implement an optimal solution for a given problem by applying a suitable design technique.	**CO1,CO2,CO3,CO4,CO5**

Learning Resources

Text Books

1. Introduction to the Design & Analysis of Algorithms, Anany Levitin, Third Edition, 2011, Pearson Education.
2. Data Structures and Algorithm Analysis in C, Mark Allen Weiss, 2002, Pearson.
3. Algorithm Design Techniques, Narasimha Karumanchi, CareerMonk Publications, 2018.

e- Resources & other digital material

1. https://www.cs.usfca.edu/~galles/visualization/Algorithms.html
2. http://littlesvr.ca/dsa-html5-animations/sorting.php
3. https://www.youtube.com/watch?v=AfYqN3fGapc

Programming with JAVA

Course Code	20SO8454	**Year**	II	**Semester**	II
Course Category	SOC	**Branch**	CSE	**Course Type**	Practical
Credits	2	**L-T-P**	1-0-2	**Prerequisites**	Programming for Problem Solving,
Continuous Internal Evaluation :	-	**Semester End Evaluation:**	50	**Total Marks:**	50

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Apply object oriented principles/ Java constructs for solving problems	**L3**
CO2	Implement programs as an individual on different IDE/ online platforms.	**L3**
CO3	Develop an effective report based on various programs implemented.	**L3**
CO4	Apply technical knowledge for a given problem and express with an effective oral communication.	**L3**
CO5	Analyze outputs using given constraints/test cases.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1		√											√	
CO2									√					
CO3										√				
CO4									√		√			
CO5			√			√								

Syllabus		
Expt No.	**Contents**	**Mapped CO**
1	Implement the concept of instantiation of objects using classes.	**CO1,CO2,CO3,CO4,CO5**
2	Use String and String Tokenizer classes to develop Java programs.	**CO1,CO2,CO3,CO4,CO5**
3	Implement reusability concept through inheritance.	**CO1,CO2,CO3,CO4,CO5**
4	Implement concept of Polymorphism using method overloading and overriding.	**CO1,CO2,CO3,CO4,CO5**
5	Develop Java programs using Abstract Class to achieve partial abstraction.	**CO1,CO2,CO3,CO4,CO5**
6	Use interfaces to develop Java programs with complete abstraction.	**CO1,CO2,CO3,CO4,CO5**
7	Create a package and access members from the package to avoid naming conflicts.	**CO1,CO2,CO3,CO4,CO5**
8	Implement Exception handling to build robust programs.	**CO1,CO2,CO3,CO4,CO5**
9	Develop Java programs using Multithreading for process synchronization.	**CO1,CO2,CO3,CO4,CO5**
10	Implement various data structures using Collection Framework.	**CO1,CO2,CO3,CO4,CO5**

Case Study: Apply object oriented concepts to build an application.

Learning Resources

Text Books

1. Java - The Complete Reference, Herbert Schildt, Ninth Edition, 2014, McGraw-Hill.

e-Resources & other digital material

1. http://www.learnjavaonline.org/
2. http://vtc.internshala.com/signup/course_details2.php?course=java101
3. https://nptel.ac.in/courses/106/105/106105191/
4. https://www.udemy.com/course/java-tutorial/
5. https://www.decodejava.com/
6. https://www.codecademy.com/learn/learn-java
7. https://www.w3schools.com/java/

Mathematics for Machine Learning

Course Code	20CS6421	Year	II	Semester	II
Course Category	Honors	Branch	CSE	Course Type	Theory
Credits	4	L-T-P	4-0-0	Prerequisites	-
Continuous Evaluation :	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the basic notions of machine learning and of the related basic mathematical tools.	**L2**
CO2	Apply machine learning algorithms on synthetic and real data sets using mathematical concepts.	**L3**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3: High, 2: Medium, 1: Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√													
CO2	√								√	√			√	√

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Linear Algebra:** Systems of Linear Equations, Matrices, Solving Systems of Linear Equations, Vector Spaces, Linear Independence, Basis and Rank, Linear Mappings, Affine Spaces	**CO1,CO2**
II	**Analytic Geometry:** Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement, Inner Product of Functions, Orthogonal Projections, Rotations	**CO1,CO2**
III	**Matrix Decompositions:** Determinant and Trace, Eigenvalues and Eigenvectors, Cholesky Decomposition, Eigendecomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation, Matrix Phylogeny	**CO1,CO2**
IV	**Vector Calculus :** Differentiation of Univariate Functions, Partial Differentiation and Gradients, Gradients of Vector-Valued Functions, Gradients of Matrices, Useful Identities for Computing Gradients, Backpropagation and Automatic Differentiation, Higher-Order Derivatives, Linearization and Multivariate Taylor Series	**CO1,CO2**
V	**Probability and Distributions:** Construction of a Probability Space, Discrete and Continuous Probabilities, Sum Rule, Product Rule, and Bayes' Theorem, Summary Statistics and Independence, Gaussian Distribution, Conjugacy and the Exponential Family, Change of Variables/Inverse Transform **Continuous Optimization:** Optimization Using Gradient Descent, Constrained Optimization and Lagrange Multipliers, Convex Optimization	**CO1,CO2**

Learning Resources	
Text Books	1. "Mathematics for Machine Learning", Marc Peter Deisenroth, A. Aldo Faisal and Cheng Soon Ong, Cambridge University Press. 2. The Elements of Statistical Learning: Data Mining, Inference, and Prediction, 2^{nd} Edition, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer 2017.
Reference Books	1. Machine Learning: An Applied Mathematics Introduction, Paul Wilmott, Panda Ohana Publishing 2019.

Advanced Python Programming

Course Code	20CS6421	**Year**	II	**Semester**	II
Course Category	Honors	**Branch**	CSE	**Course Type**	Integrated
Credits	4	**L-T-P**	3-0-2	**Prerequisites**	Python Programming
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand python standard template library modules.	**L2**
CO2	Apply various text processing and mathematical functions to solve complex problems.	**L3**
CO3	Apply functional styles for implementing algorithms elegantly and concisely.	**L3**
CO4	Apply suitable data structures for efficient use of memory.	**L3**
CO5	Analyze programs using STL modules.	**L4**
CO6	Develop python programs for a given problem.	**L3**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3: High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√									√		√		
CO2	√									√		√		
CO3	√									√		√		
CO4	√									√		√		
CO5		√								√		√		

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Mathematics:** ***decimal*-**Fixed and Floating Point Math, ***Fractions*-**Rational Numbers, ***random*-**Pseudorandom Number Generators, ***math*-**Mathematical Functions, ***and statistics*-**Statistical Calculations.	**CO1,CO2,CO5**
II	**Text:** ***string***-Text Constants and Templates, ***textwrap*-**Formatting Text Paragraphs, ***re*-**Regular Expressions, ***difflib*-**Compare Sequences.	**CO1,CO2,CO5**
III	**Algorithms:** ***functools*-**Tools for Manipulating Functions, ***itertools*-**Iterator Functions, ***operator*-** Functional Interface to Built-in Operators, ***contextlib*-**Context Manager Utilities. **Threads:*threading*-**Manage concurrent Operations, ***multiprocessing*-**Manage Process like Threads.	**CO1,CO3,CO4,CO5**
IV	**Data Structures:** ***enum*-**Enumration Type, ***collections*-**Container Data Types, ***array*-**Sequence of Fixed-Type Data, ***heapq*-**Heap Sort Algorithm, ***bisect*-**Maintain Lists in Sorted Order.	**CO1,CO4,CO5**
V	**Data Structures:** ***Queue*-**Thread_Safe FIFO Implementation, ***struct*-**Binary Data Structures, ***weakref*-**Impermanent Reference to Objects, ***copy*-**Duplicate Objects, ***pprint*-**Pretty Print Data Structures.	**CO1,CO4,CO5**

Expt. No.	**Experiment Details**	**Mapped CO**
1.	Implement programs using various functions in decimal, fractions, random, math and statistics modules.	**CO1,CO2,CO3,CO4,CO5**
2.	Develop a solution to the given problem by using suitable mathematical functions.	**CO1,CO2,CO3,CO4,CO5**
3.	Implement various functions in string, textwrap, re, difflib modules.	**CO1,CO2,CO3,CO4,CO5**
4.	Build solution to the given problem by using advanced text manipulation functions.	**CO1,CO2,CO3,CO4,CO5**
5.	Implement various functions in functools, itertools, operator, contexlib modules.	**CO1,CO2,CO3,CO4,CO5**
6.	Develop programs using functions in threading, multiprocessing modules.	**CO1,CO2,CO3,CO4,CO5**
7.	Develop a solution to the given problem to achieve concurrency.	**CO1,CO2,CO3,CO4,CO5**
8.	Implement programs using functions in enum, collections, array, heapq, bisect, queue, struct, weakref, copy, pprint modules.	**CO1,CO2,CO3,CO4,CO5**

Learning Resources
Text Books
1. The Python 3 Standard Library by Example, Doug Hellmann, 2017, Pearson.
References Text Book
1. Modern Python Standard Library Cookbook, Alessandro Molina, 2018, Packt. 2. The Python Library Reference: Release 3.6.4 - Book 1 of 2, Guido Van Rossum, Python Development Team, 2018, 12th Media Services.
e-Resources and other Digital Material
1. https://media.oiipdf.com/pdf/21fee97b-17fd-4581-8eed-5d3fcdd0c86a.pdf 2. https://docs.python.org/3/library/index.html 3. https://github.com/lanzhiwang/python3-standard-library-example/tree/master/source 4. https://github.com/packtpublishing/modern-python-standard-library-cookbook

ADVANCED COMPUTER ARCHITECTURE

Course Code	20CS6421	**Year**	II	**Semester**	II
Course Category	**Honors**	**Branch**	CSE	**Course Type**	Theory
Credits	4	**L-T-P**	4-0-0	**Prerequisites**	-
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

COURSE OUTCOMES		
Upon successful completion of the course, Student will be able to		
CO1	Understand Technological Trends in Computer Architecture	**L2**
CO2	Apply organizational enhancements to the processor for improving performance.	**L3**
CO3	Apply Reduced instruction set architecture to optimize pipelining and to enhance instruction level parallelism.	**L3**
CO4	Analyze parallel processing capabilities of a system.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1														
CO2	√								√	√				√
CO3	√								√	√				√
CO4		√							√	√				√

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Processor Structure and Function:** Processor Organization, Register Organization, The Instruction Cycle, Instruction Pipelining.	**CO1, CO2**
II	**Reduced Instruction Set Computers (RISCs):** Instruction Execution Characteristics, The Use of a Large Register File, Compiler-Based Register Optimization, Reduced Instruction Set Architecture, RISC pipelining.	**CO1, CO3**
III	**Instruction-Level Parallelism and Superscalar Processors:** Overview, Design Issues , Pentium 4, ARM Cortex-A8.	**CO1, CO3**
IV	**Parallel Processing:** The Use of Multiple Processors, Symmetric Multiprocessors, Cache Coherence and the MESI Protocol, Multithreading and Chip Multiprocessors, Clusters, Nonuniform Memory Access Computers.	**CO1, CO4**
V	**Multicore Computers:** Hardware Performance Issues, Software Performance Issues, Multicore Organization, Intel x86 Multicore Organization.ARM11 MPCore.	**CO1, CO4**

Learning Resources
Text Books
1. "Computer Organization and Architecture- Design for performance", William Stallings, Pearson Education, Eighth Edition, 2013.
References
1. "Computer Architecture - A Quantitative Approach", John L. Hennessy and David A. Patterson, Morgan Kaufmann/Elsevier, Fifth edition, 2012. **2.** "Advanced Computer Architecture", Kai Hwang, Tata McGraw-Hill Education, Second Edition, 2013.
e- Resources & other digital material
1. https://nptel.ac.in/courses/106103206 2. https://nptel.ac.in/courses/106102229

COMPUTATIONAL THINKING

Course Code	20CS5401	**Year**	II	**Semester**	II
Course Category	Minor	**Branch**	Other branches	**Course Type**	Theory
Credits	4	**L-T-P**	4-0-0	**Prerequisites**	NIL
Continuous Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the fundamental concepts of searching, sorting and data processing over numerical and textual data.	**L2**
CO2	Apply the knowledge of fundamental algorithms and factoring methods to model a flowchart for a given problem.	**L3**
CO3	Apply the concepts of data processing techniques to develop algorithms for a given problem.	**L3**
CO4	Analyze the given problem to develop an efficient solution using sorting or pattern searching techniques.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3: Substantial, 2: Moderate, 1: Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√												√	√
CO2	√												√	√
CO3	√												√	√
CO4			√						√	√			√	√

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction to computational thinking :** What is computational thinking, Pillars of computational thinking - Decomposition, Pattern Recognition, Data Representation and Abstraction, Algorithm Design. Introduction to Algorithms and Flowcharts, Fundamental Algorithms: Exchanging the values of two variables, Counting, Summation of a set of numbers, Factorial Computation, Generation of Fibonacci sequence, Reversing the digits of an integer.	**CO1, CO2**
II	**Factoring Methods**: Finding the square root of a number, smallest divisor of an integer, Greatest common divisor of two integers, Generating prime numbers, Computing Prime Factors of an integer, generation of pseudo random numbers, raising a number to a large power, computing nth Fibonacci number.	**CO1, CO2**
III	**Array Techniques**: Array order reversal, Array counting or Histogramming, finding the maximum number in a set, removal of duplicates from an ordered array, partitioning an array, finding the kth smallest element.	**CO1, CO3**
IV	**Merging, Sorting and Searching**: The two-way merge, sorting by selection, sorting by exchange, sorting by Insertion, Linear search, binary search.	**CO1, CO3, CO4**
V	**Text Processing and Pattern Searching**: Keyword searching in text, Text line editing, Linear pattern search, Sub linear pattern search.	**CO1, CO3, CO4**

Learning Resources	
Text Books	1. How to Solve it by Computer, R.G. Dromey, First Edition, Pearson, 2006.
Reference Books	1. Fundamentals of Computers, Reema Thareja, Oxford University Press. 2. Flowchart and Algorithm Basics: The Art of Programming, A B Chaudhuri, 2020, Mercury Learning and Information. 3. Algorithms Unlocked, Thomas H. Cormen, 2013, The MIT Press. 4. An Introduction to Programming and Problem Solving with Pascal, Michael Schneider, Steven W. Weingart, David M. Perlman, Second Edition, 2011, Wiley India
e- Resources & other digital material	1. https://onlinecourses.swayam2.ac.in/nou20_cs03/preview 2. https://www.coursera.org/learn/problem-solving?#about 3. https://www.udemy.com/course/flowchartingcourse/ 4. https://raptor.martincarlisle.com/

Software Engineering

Course Code	20CS3501	**Year**	III	**Semester**	I
Course Category	PCC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	OOP
Continuous Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the fundamentals of software engineering	**L2**
CO2	Apply various lifecycle activities for project development	**L3**
CO3	Apply Risk and Quality Management Strategies for project development	**L3**
CO4	Analyze the various requirements, design and Testing Techniques to select the appropriate techniques for the software project development	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√													
CO2	√									√				
CO3										√			√	
CO4		√							√	√				

Syllabus		Mapped CO
Unit No.	**Contents**	
I	Introduction to Software Engineering: The Nature of Software, The changing Nature of Software, Software Process, Software Engineering Practice, Software Development myths. Process models: Perspective process Models, Unified Process Model, **Agile process model**	**CO1,CO4**
II	Requirements engineering: Requirements engineering, Establishing the Groundwork, Eliciting Requirements, Developing Use Cases, Building the Analysis Model, Negotiating requirements. Agile Requirements: User Stories, Backlog Management. Requirements Analysis: Scenario Based Modeling.	**CO1,CO2,CO4**
III	Design Engineering: Design process, Design concepts, The Design Model. Architectural design: Software architecture, Architectural styles, Architectural Design, Agility and Architecture User interface design: Golden rules	**CO1,CO2,CO4**
IV	Software Testing Strategies: A strategic approach to software testing, Test strategies for conventional software, Test strategies for Object-Oriented software Validation Testing, System Testing, The art of Debugging. Testing Conventional Applications: Software testing fundamentals, White-Box testing, Basis path testing, Control structure testing, Black-Box testing Agile Testing, User Acceptance Test.	**CO1,CO2,CO4**
V	Risk management: Reactive vs. Proactive Risk strategies, software risks, Risk identification, Risk projection, Risk refinement, RMMM, RMMM Plan. Software Quality Assurance: Elements of SQA, SQA Tasks, Goals, and Metrics, Statistical Software Quality Assurance, Software Reliability, The ISO 9000 Quality Standards, The SQA Plan. Agile approach to Risk and Quality Assurance	**CO1,CO3,CO4**

Learning Resources
Text Books
1. Software Engineering: A Practitioner's Approach, Roger S. Pressman, Bruce R. Maxim, Eighth edition, 2015, McGraw Hill, International Edition 2. Robert C. Martin ,Agile Software Development, Principles, Patterns, and Practices Alan Apt Series (2011)
References
1. Software Engineering, Ian Sommerville, Seventh edition, 2004, Pearson, India 2. Software Engineering, K.K. Agarwal &Yogesh Singh, 2007, New Age International Publishers. 3. Software Engineering Principles and Practice, Waman S Jawadekar, 2004, McGraw-Hill. 4. Fundamentals of Software Engineering, Rajib Mall, Fourth edition, 2009, PHI. 5. Succeeding with Agile : Software Development Using Scrum, Pearson (2010)
e-Resources & other digital material
1. https://onlinecourses.nptel.ac.in/noc20_cs68 2. *https://thedigitalprojectmanager.com*

Database Management Systems

Course Code	20CS3502	**Year**	III	**Semester**	I
Course Category	PCC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Engineering Mathematics -1, Data Structures
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the basic concepts of database management systems	**L2**
CO2	Apply SQL or Relational Algebra operations to find solutions for a given application	**L3**
CO3	Apply normalization techniques to improve database design	**L3**
CO4	Analyze a real time scenario to use Conceptual and Relational data models for designing the database	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√													
CO2													√	
CO3	√													
CO4		√				√			√	√				

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction to Databases:** Characteristics of the Database Approach, Advantages of using the DBMS Approach, A Brief History of Database Applications, Data Models, Schemas and Instances, Three-Schema Architecture and Data Independence, Database Languages and Interfaces, The Database System environment, Centralized and Client-Server Architecture for DBMSs.	**CO1**
II	**Conceptual Data Modeling:** High-Level Conceptual Data Models for Database Design, A Sample Database Application, Entity Types, Entity Sets, Attributes and Keys, Relationship Types, Relationship Sets, Roles, and Structural Constraints, Weak Entity Types, Refining the ER Design, ER Diagrams, Naming Conventions and Design Issues, Relationship Types of Degree Higher Than Two. Relational Database Design Using ER-to-Relational Mapping.	**CO1,CO4**
III	**Relational Model:** The Relational Model Concepts, Relational Model Constraints and Relational Database Schemas. Basic SQL: SQL Data Definition and Data Types, Specifying Constraints in SQL, Basic retrieval Queries in SQL ,INSERT, DELETE AND UPDATE Statements in SQL More SQL: More complex SQL retrieval queries Advanced Queries, Specifying constraints as Assertions and Actions as Triggers, Views in SQL **Relational Algebra**: Unary Relational Operations: Select and Project, Relational Algebra Operations from SetTheory, Binary Relational Operations: Join and Division, Examples of Queries in Relational Algebra.	**CO1,CO2, CO4**
IV	**Database Design Theory and Normalization:** Functional Dependencies, Normal forms based on Primary Keys, General definitions of Second and Third Normal Forms , Boyce-Codd Normal Form, Multi valued Dependencies and Fourth Normal Form, Join Dependencies and Fifth Normal Form.	**CO1,CO3, CO4**
V	**Transaction Processing:** Introduction, Transaction and System Concepts, Desirable Properties of Transactions, Characterizing Schedules Based on Recoverability & Serializability, Transaction Support in SQL. **Introduction to Concurrency Control:** Two-Phase Locking Techniques for concurrency control: Types of Locks and System Lock Tables, Guaranteeing Serializability by Two-Phase Locking. **Introduction to Recovery Protocols**: Recovery Concepts, No- UNDO/REDO Recovery Based on Deferred Update, Recovery Techniques Based on Immediate Update, Shadow Paging.	**CO1**

Learning Resources

Text Books

1. Fundamentals of Database Systems, Ramez Elmasri,ShamkantB. Navathe, Seventh edition, Pearson.

References

1. Data base System Concepts, Abraham Silberschatz, Henry F Korth, S. Sudarshan, FifthEdition, McGraw Hill.
2. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, Third Edition,TMH.
3. Introduction to Database Systems, C.J.Date, Eigth Edition , Pearson

e-Resources and other Digital Material:

1. https://nptel.ac.in/courses/106/105/106105175/
2. https://onlinecourses.nptel.ac.in/noc21_cs04/ 3. https://nptel.ac.in/courses/106/106/106106093/

Computer Networks

Course Code	20CS3503	**Year**	II	**Semester**	I
Course Category	PCC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Basic Electrical and Electronics Engineering
Continuous Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the basic concepts and protocols of different layers.	**L2**
CO2	Apply Error Correction or MAC Protocol mechanism for a given scenario.	**L3**
CO3	Apply various Addressing mechanisms /Routing protocols for a given network.	**L3**
CO4	Apply appropriate Transport & Application layer protocol for a given context.	**L3**
CO5	Analyze the given scenario and use appropriate methods/mechanisms/protocol for designing a network	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√													
CO2	√													
CO3	√													
CO4													√	
CO5		√							√	√				

Syllabus		Mapped CO
Unit No.	**Contents**	
I	**Introduction :-** Networks, Network Types, Network Models :-The Protocol Layering , TCP/IP Protocol Suite, The OSI Model, **Physical Layer :-** Transmission Media - Guided Media, Un-Guided Media **Data-Link Layer:** Introduction to Data-Link Layer - Introduction, Link-Layer Addressing. Error Detection and Correction - Introduction, Cyclic Redundancy Check. Data Link Control (DLC) - DLC Services. Media Access Control (MAC) - Random Access, Controlled Access.	**CO1,CO2**
II	**Network Layer:** Introduction to Network Layer - Network-Layer Services, Packet Switching, Network-Layer Performance, IPv4 Addresses, Forwarding of IP Packets. **Next Generation IP-** IPv6 Addressing, The IPv6 Protocol.	**CO1,CO2,CO5**
III	**Network-Layer Protocols -** Internet Protocol (IP), Unicast Routing - Introduction, Routing Algorithms- Distance vector and Link State Routing, Unicast Routing Protocols.	**CO1,CO2,CO4, CO5**
IV	**Transport Layer:** Introduction to Transport Layer-Introduction, Transport-Layer Protocols. Transport Layer Protocols-Introduction, User Datagram Protocol(UDP), Transmission Control Protocol(TCP)	**CO1,CO3,CO5**
V	**Application Layer:** Standard Client-Server Protocols-World Wide Web and HTTP, FTP, Electronic Mail, Telnet, Secure Shell (SSH), Domain Name System (DNS)	**CO1,CO3**

Learning Resources
Text Books
1. Data Communications and Networking, Behrouz A. Forouzan, Fifth Edition, McGrawHill
References
1. Computer Networking A Top-Down Approach, James F. Kurose, Keith W. Ross, Sixth Edition, Pearson Education 2. Computer Networks - A Systems Approach, Larry L. Peterson, Bruce S. Davie, Fifth Edition, Morgan Kaufmann.
e-Resources & other digital material
1. https://nptel.ac.in/courses/106/105/106105183/ 2. https://nptel.ac.in/courses/106/105/106105081/ 3. https://www.youtube.com/playlist?list=PLEAYkSg4uSQ2NMmzNNsEK5RVbhxqx0BZF

AIR POLLUTION & CONTROL

(Open Elective – I)

Course Code	20CE2501A	**Year**	III	**Semester**	I
Course Category	OE-1	**Branch**	Offered by CE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	-
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		**Blooms Taxonomy Level**
Upon successful completion of the course, the student will be able to		
CO1	**Understand** the various types of air pollutants and their effects.	**L2**
CO2	**Examine** the behavior of air pollutants with reference to meteorological parameters	**L3**
CO3	**Analyze** the samples, pollutants from atmosphere	**L4**
CO4	**Identify and Understand** the different methods to control the particulate matter	**L4**
CO5	**Categorize and understand** the methods for the control of pollutants from gaseous emissions	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√	√				√	√						√	√
CO2	√	√				√	√						√	√
CO3	√	√	√			√	√						√	√
CO4	√	√	√		√	√	√						√	√
CO5	√	√	√		√	√	√						√	√

Syllabus		
Unit No	**Contents**	**Mapped CO**
I	**AIR POLLUTION & EFFECTS** Air pollution - definitions-scope, significance -air pollutants -classification –natural and artificial-primary and secondary air pollutants. Effect of air pollutants on man-material and vegetation-global effects of air pollution greenhouse effect, acid rains and ozone layer threat.	**CO1**
II	**METEROLOGY AND PLUME DISPERSION** Properties of atmosphere-heat, pressure, wind forces, moisture and relative humidity influence of meteorological phenomenon on air quality- wind rose diagram, inversions and Plume behavior, Gaussian model for plume dispersion.	**CO2**
III	**SAMPLING OF AIR POLLUTION**: Stack sampler; Sampling Procedure- Sampling point – size – Isokinetic Conditions – Sampling of Particulate matter and Gases. Sampling methods–Indian standard methods of analysis of SO_2 and NO_x gases- Air Quality and Emission standards.	**CO3**
IV	**METHODS OF CONTROLLING AIR POLLUTION** Different means of control of effluent discharges into the atmosphere. Control of Particulate matter by equipment -Settling chamber, inertial separators, fabric filters, wet scrubbers, Electrostatic Precipitators	**CO4**
V	**CONTROL OF GASEOUS POLLUTANTS:** Controlling methods of Gaseous Emissions- combustion, adsorption, absorption,closed collections and recovery systems- Control of SO_2 and NO_x gases.	**CO5**

Learning Resources
Text books
1. Air Pollution and Control by Rao M.N and Rao, H.N., Tata McGraw Hill, New Delhi 2007. 2. Environmental Engineering and Management, (2nd Edition) by Suresh, S. K. Kartarai & Sons, 2005.
References
1. An Introduction to Air pollution by Trivedy, R.K., B. S. Publications, 2005. 2. Air pollution by Wark and Warner, Addison-Wesley Publications, 1998.
e-Resources and other Digital Material
https://nptel.ac.in/courses/105102089/8

SENSOR TECHNOLOGY
(Open Elective – I)

Course Code	20EC2501A	**Year**	III	**Semester**	I
Course Category	OE-1	**Branch**	Offered by EC	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the concept of sensors and its characteristics. (L2)
CO2	**Select** the physical principles of sensing based on sensor signals and systems (**L**3)
CO3	**Identify** the sensor interfacing with various electronics circuits (L3)
CO4	**Utilize** the practical approach in design of technology based on different sensors.(L3)
CO5	**List** various sensor materials and technology used in designing sensors.(L4)

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
*** - Average value indicates course correlation strength with mapped PO**

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√											√		
CO2	√												√	
CO3	√				√								√	
CO4	√				√								√	
CO5		√												√

Syllabus

Unit No.	**Contents**	**Mapped CO**
I	**Sensors Fundamentals and Characteristics** Sensors, Signals and Systems; Sensor Classification; Units of Measurements; Sensor Characteristics	CO1,CO2
II	**Physical Principles of Sensing** Electric Charges, Fields, and Potentials; Capacitance; Magnetism; Induction; Resistance; Piezoelectric Effect; Hall Effect; Temperature and Thermal Properties of Material; Heat Transfer; Light; Dynamic Models of Sensor Elements	CO1,CO2
III	**Interface Electronic Circuits** Input Characteristics of Interface Circuits, Amplifiers, Excitation Circuits, Analog to Digital Converters, Direct Digitization and Processing, Bridge Circuits, Data Transmission, Batteries for Low Power Sensors	CO1,CO3

IV	**Sensors in Different Application Area** Occupancy and Motion Detectors; Position, Displacement, and Level; Velocity and Acceleration; Force, Strain, and Tactile Sensors; Pressure Sensors, Temperature Sensors	CO1,CO4
V	**Sensor Materials and Technologies** Materials, Surface Processing, Nano-Technology	CO1,CO5

Learning Resources
Text Books
1. J. Fraden, Handbook of Modern Sensors:Physical, Designs, and Applications, AIP Press, Springer 2. D. Patranabis, Sensors and Transducers, PHI Publication, New Delhi
Reference Books
1. Mechatronics- Ganesh S. Hegde, Published by University Science Press (An imprint of Laxmi Publication Private Limited).
e- Resources & other digital material
1. http://www.infocobuild.com/education/audio-video-courses/electronics/IndustrialInstrumentation-IIT-Kharagpur/lecture-34.html

ELECTRONIC INSTRUMENTATION
(Open Elective – I)

Course Code	20EC2501B	Year	III	Semester	I
Course Category	OE - 1	Branch	Common to All	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	Nil
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Comprehend** the concepts of Electronic instrumentation (L2)
CO2	**Identify** the Performance characteristics of instruments (L3)
CO3	**Illustrate** the different types of Signal Generator, Wave Analyzers& Bridges (L3)
CO4	**Analyze** the various types of Oscilloscopes (L4)
CO5	**Illustrate** the concept of various types of Transducers.(L3)

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	√									√			√	√
CO2	√									√			√	√
CO3	√									√			√	√
CO4	√	√								√			√	√
CO5	√									√			√	√

Syllabus		
Unit No.	Contents	Mapped CO
I	**Performance characteristics of instruments:** Static characteristics, Errors in Measurement, Dynamic Characteristics, DC Voltmeters- Multi range, Range extension, Thermo couple type RF ammeter, Ohmmeters series type, shunt type, Miltimeteres for Voltage, Current and resistance measurements.	CO1,CO2
II	**Signal Generator& Wave Analyzers:** Fixed and variable signal	CO1,CO3

	generators, AF oscillators, Standard signal generator, AF sine and square wave signal generators, Function Generators, Basic wave analyzers, Frequency selective wave analyzers, Hetero- dyne wave analyzer, Harmonic Distortion Analyzers, Spectrum Analyzers.	
III	**Oscilloscopes:** Dual trace oscilloscope, Measurement of amplitude, period and frequency, Sampling oscilloscope, storage oscilloscope, digital readout oscilloscope, digital storage oscilloscope.	CO1,CO4
IV	**Bridges:** Wheatstone Bridge, AC Bridges Measurement of inductance- Maxwell's bridge, Measurement of capacitance - Schearing Bridge. Wien Bridge, Q-meter.	CO1,CO3
V	**Transducers:** Resistance, Capacitance, inductance, Strain gauges, LVDT, Piezo Electric transducers, Resistance Thermometers, Thermocouples, Thermistors, Sensistors, force, pressure, velocity, humidity, moisture, speed, Data acquisition system.	CO1,CO5

--

Learning Resources
Text Books
1. Electronic instrumentation, - H.S.Kalsi, Tata McGraw Hill, 2nd edition 2004. 2. Modern Electronic Instrumentation and Measurement Techniques – A.D. Helfrick and W.D. Cooper, PHI, 5th Edition, 2002.
Reference Books
1. Electronic Instrumentation & Measurements - David A. Bell, PHI, 2nd Edition,2003. 2. Electronic Test Instruments, Analog and Digital Measurements - Robert A.twitter, Pearson Education, 2nd Edition,2004

ELECTRICAL SAFETY

Course Code	20EE2501A	**Year**	III	**Semester(s)**	I
Course Category	Open Elective-I	**Branch**	EEE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	-
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the Indian power sector organization and Electricity rules, electrical safety in residential, commercial, agriculture, hazardous areas and use of fire extinguishers. **(L2)**
CO2	**Assess** the Electrical Safety measures in operation and maintenance. **(L3)**
CO3	**Apply** the **s**afety measures during installation, testing and commissioning. **(L3)**
CO4	**Analyze** the Electrical Safety, Electric Shocks and Their Prevention. **(L4)**
CO5	**Examine** the hazardous areas and the fire extinguishers. **(L4)**
CO6	**Submit** a report on safety measures.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	√					√		√				√		
CO3	√							√				√		
CO4		√				√								
CO5		√												
CO6	√	√						√	√	√				

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction To Electrical Safety, Shocks And Their Prevention:** Terms and definitions, objectives of safety and security measures, Hazards associated with electric current and voltage, principles of electrical safety, Approaches to prevent Accidents. Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings andshop.	CO1, CO2 CO3, CO4, CO6

II	**Electrical Safety in Residential, Commercial and Agricultural Installations**: Wiring and fitting –Domestic appliances –water tap giving shock –shock from wet wall –fan firing shock –multi-storied building – Temporary installations – Agricultural pump installation –Do's and Don'ts for safety in the use of domesticelectrical appliances.	CO1, CO2 CO4, CO6
III	**Electrical Safety during Installation, Testing and Commissioning, Operation and Maintenance**: Preliminary preparations –safe sequence – risk ofplant and equipment –safety documentation –field quality and safety -personal protective equipment –safety clearance notice –safety precautions –safeguards for operators –safety.	CO1, CO3 CO4, CO6
IV	**Electrical Safety in Hazardous Areas**: Hazardous zones –class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipment's for hazardous locations **Equipment Earthing**: Introduction, Equipment earthing, Functional requirements of Earthing system, Neutral grounding, Protection against energized Metal parts.	CO1, CO2, CO5, CO6
V	**Fire Extinguishers**: Fundamentals of fire-initiation of fires, types; extinguishing techniques, prevention of fire, types of fire extinguishers, fire detection and alarm system; CO_2, Halogen gas and foam schemes.	CO1, CO5, CO6

Learning Resources

Text Books

1. Rao, S. and Saluja, H.L., "Electrical Safety, Fire Safety Engineering and Safety Management", Khanna Publishers, 4th edition, 2020
2. John Codick, "Electrical safety hand book", McGraw Hill Inc., 3rd edition, 2006

Reference Books

1. Cooper.W.F, "Electrical safety Engineering", Newnes-Butterworth Company, 3rd edition, 1998.
2. Kothari, D.P and Nagrath, I.J., "Power System Engineering", McGraw Hill, 3rd edition, 2019.
3. Wadhwa, C.L., "Electric Power Systems", New Age International, 8th edition, 2004.

DESIGN THINKING

Course Code	20ME2501A	Year	III	Semester	I
Course Category	OE-I	**Offering Branch**	ME	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Pre-requisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes: Upon successful completion of the course, the student will be able to

CO	Statement	Skill	BTS	Units
CO1	Understand the principles of design thinking and its approaches	Understand	L2	1,2,3,4,5
CO2	Apply the empathy, the Define phase and develop an idea through ideation Techniques in human-centered design problems.	Apply	L3	1,2,3
CO3	Apply the design thinking techniques for innovation processes	Apply	L3	1,5
CO4	Analyze the prototype and test in a design thinking context.	Analyze	L4	1,4

Contribution of Course Outcomes towards achievement of Program Outcomes& Strength of correlations(3:High, 2:Moderate,1: Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√			√	√		√	√	√	√	√	√	√	
CO2	√			√	√		√	√	√	√	√	√	√	
CO3	√			√	√		√	√	√	√	√	√	√	
CO4	√			√	√		√	√	√	√	√	√	√	

Syllabus

Unit	Contents	Mapped CO
I	**Introduction to Design Thinking** An insight into Design, Design Methodology, the origin of Design thinking, Design thinking Vs Engineering thinking, the importance of Design Thinking, Design Vs Design thinking, understanding Design thinking and its various process models or frameworks, Stanford process models and its five stages, features of design thinking, application of Design thinking	**CO1 CO2 CO3 CO4**
II	**Empathize in Design Thinking:** Human-Centered Design (HCD) process, explanation of HCD design thinking with examples, Role of Empathy in design thinking, persona creation and its importance, tools of empathy: Empathy maps, advantages and disadvantages of empathy maps, Customer journey map and its advantages & disadvantages, Mind Maps, and its uses, understanding empathy tools.	**CO1 CO2**
III	**Define Phase and Ideation:** Explore define phase in Design Thinking, Methods of Define phase. Introduction to ideation Methods, convention methods for ideation, intuitive methods: Brainstorming	**CO1 CO2**

	storyboard telling, select ideas from ideation Methods: Bingo Selection, Six Thinking Hats.	
IV	**Prototyping and Testing**: Prototyping and methods of prototyping, Difference between low fidelity and high-fidelity prototypes, paper prototyping, techniques for implementing paper prototyping, Digital prototyping, user testing methods, Advantages, and disadvantages of user Testing/ Validation	**CO1** **CO4**
V	**Design Thinking for Innovation**: Innovation in Design Thinking, Definition of innovation, the art of innovation, types of innovations, product innovation, process innovation, and organizational innovation, characteristics of innovation, levels of innovation, Innovation towards design, Case studies	**CO1** **CO3**

Learning Resources

Text books:

1. Changebydesign,Tim Brown,2009,HarperCollins
2. Engineering design, George E Dieter,4th Revisededition,2009 McGraw Hill.

Reference books

1. Design Thinking for Strategic Innovation, Idris Mootee,2013, JohnWiley&Sons
2. DesignThinking-TheGuidebook–FacilitatedbytheRoyalCivilserviceCommission, Bhutan
3. Design Methods: A Structured Approach for DrivingInnovation in Your Organization, Vijay Kumar, FirstEdition, 2012, Wiley
4. Human-Centered Design Toolkit: An Open SourceToolkittoInspireNewSolutionsintheDeveloping
5. World,IDEO,SecondEdition,2011, IDEO

e- Resources & other digital material

1. https://www.interaction-desiqn.ora/literature/topics/desiqn-thinkinq
2. https://www.interaction-desiqn.prq/literature/article/how-tq-<eve'op-anempath\capproach-in-design-thinking

LOGISTICS & SUPPLY CHAIN MANAGEMENT

Course Code	20ME2501B	Year	III	Semester	I
Course Category	OE-I	Offering Branch	ME	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	Nil
Continuous Internal Evaluation	30	Semester End Evaluation	70	Total Marks	100

Course Outcomes: Upon successful completion of the course, the student will be able to				
CO	**Statement**	**Skill**	**BTS**	**Units**
CO1	Explain the importance of Supply Chain Management	Understand	L2	1,2,3,4,5
CO2	Illustrate Inventory control techniques	Apply	L3	2
CO3	Illustrate various issues in Supply Chain Management	Apply	L3	5
CO4	Interpret supply chain strategies and procurement strategies	Apply	L3	4
CO5	Design Supply Chain Networks suitable for various market conditions	Analyse	L4	3

Contribution of Course Outcomes towards achievement of Program Outcomes& Strength of correlations

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		√							√		√			√
CO2		√							√		√			√
CO3		√							√		√			√
CO4		√							√		√			√
CO5		√							√		√			√

Syllabus		
UNIT	**Content**	**Mapped CO**
I	**Introduction to Supply Chain Management (SCM):** Concept of supply management and SCM, importance of supply chain flows, core competency, value chain, elements of supply chain efficiency, key issues in SCM, decision phases, supply chain integration, process view of a supply chain, competitive strategy and supply chain strategies, uncertainties in supply chain, supply chain drivers.	**CO1**
II	**Inventory Management**: Introduction, selective control techniques, cost involved in inventory system, single stage inventory control, economic lot size models, application to economic production quantity, effect of demand uncertainty, single period models, initial inventory, multiple order opportunities, deterministic models, quantity discounts. periodic and quantity review policies, mathematical modeling under known stock out costs and service levels, joint replenishment for multiple items, inventory system constraints, working capital restrictions, and storage space restrictions.	**CO1** **CO2**

III	**Designing Supply Chain Network:** Introduction, network design, factors influencing network design, data collection, data aggregation, transportation rates, warehouse costs, capacities and locations, models and data validation, key features of a network configuration, impact of uncertainty on network design, network design in uncertain environment, value of information: Bull whip effect, information sharing, information and supply chain trade-offs, distribution strategies, direct shipment distribution strategies, transshipment and selecting appropriate strategies.	**CO1 CO5**
IV	**Supply Chain Integration:** Introduction, push-pull supply chains, identifying appropriate supply chain strategy, Sourcing and procurement, outsourcing benefits, importance of suppliers, evaluating a potential supplier, supply contracts, competitive bidding and negotiation. Purchasing, objectives of purchasing, relations with other departments, centralized and decentralized purchasing, purchasing procedure, types of orders, e-procurement, tender buying, role of business in supply chains.	**CO1 CO4**
V	**Issues in Supply Chain Management:** Introduction, risk management, managing global risk, issues in international supply chain, regional differences in logistics. Local issues in supply chain, issues in natural disaster and other calamities, issues for SMEs, organized retail in India, reverse logistics.	**CO1 CO3**

Learning Resources
Text books:
1. Simchi-Levi, D. Kaminsky, P.Simchi-Levi, E. and Ravi Shankar, Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies, 3/e, Tata McGraw-Hill, 2008. 2. Chopra, S. and Meindl, Supply Chain Management: Strategy, Planning and Operations, 2/e, Pearson Education, 2004.
Reference books
1. Doebler, D.W. and Burt, D.N, Purchasing and Supply Management-Text and Cases, 6/e, McGraw-Hill, 1996. 2. Tersine, R.J, Principles of Inventory and Materials Management, 4/e, Prentice Hall, 1994.
E- Resources & other digital material
1. https://ocw.mit.edu/courses/engineering-systems-division/esd-273j-logistics-and-supply-chain management-fall-2009/lecture-notes/ 2. https://nptel.ac.in/courses/110/108/110108056/

Data Science

Course Code	20CS4501A	**Year**	III	**Semester**	I
Course Category	PEC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Engineering Mathematics -2 (Probability & Statistics)
Continuous Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the life cycle process of data science.	**L2**
CO2	Apply different data pre-processing techniques for improving data quality.	**L3**
CO3	Apply statistical methods to evaluate the data.	**L3**
CO4	Apply Statistical Learning techniques for model building, Assessment and Selection.	**L3**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√					√	√							
CO2	√									√				
CO3														√
CO4									√	√				√

Syllabus		Mapped CO
Unit No.	Contents	
I	**Introduction to Data Science-** What is Data Science? Phases of Data Science: Data Acquisition, Cleansing, Exploratory Data Analysis, Data Preparation, Data Modeling. Engineering Aspects of Data Science: Business Understanding, Data Understanding, Data Preparation, Model Building, Model Evaluation, Hyper Parameter Optimization and Deployment.	CO1
II	**Data Preprocessing:** Introduction, Data Quality, Data Cleaning- Missing Values, Noisy data, Data Integration, Data Transformation- Smoothing, Attribute construction, Aggregation, Normalization, Discretization, Data Reduction- Wavelet Transforms, Principal Components Analysis, Attribute Subset Selection, Histograms, Clustering, Sampling	CO1, CO2
III	**Random Variables and Probability Distributions:** Random variables (discrete and continuous), Probability Density Function (PDF), Probability Mass Function (PMF), and Cumulative Density Function (CDF). Discrete distributions- Uniform, Binomial, Bernoulli and Poisson distributions. Continuous Distributions- Normal distribution, Standard Normal distribution, Student's T distribution, Chi-squared distribution. Sampling Strategies: Introduction, Simple Random sampling, Systematic sampling, Stratified sampling, Cluster sampling.	CO1, CO3
IV	**Linear methods for Regression:** Introduction, Linear Regression models, Least Squares, Multiple Regression. Linear methods for Classification: Introduction, Linear discriminative analysis, Logistic Regression.	CO1, CO4
V	**Model Assessment and Selection:** Introduction, Bias, Variance and Model complexity, Bias-Variance decomposition, Optimism of the training error rate, Estimates of in-sample prediction error, Effective number of parameters, minimum description length, Holdout sets, and cross-validation.	CO1, CO4

Learning Resources

Text Books

1. Introducing Data Science, David Cielen, Arno D. B. Meysman, and Mohamed Ali, 2016, Manning Publications. (UNIT-I)
2. Data Mining: Concepts and Techniques, Jiawei Han, Micheline Kamber and Jian Pei, Third edition, Morgan Kaufmann. (UNIT-II)
3. The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Second Edition, Springer. (UNIT-III, IV, V)

References

1. Cathy O'Neil and Rachel Schutt, "Doing Data Science", O'Reilly, 2015.
2. Data Science from Scratch: First Principles with Python, Joel Grus, Second edition, 2019, O'Reilly
3. Statistics, Robert S. Witte and John S. Witte, Eleventh Edition, 2017, Wiley Publications.

e- Resources & Other digital material
1. https://nptel.ac.in/courses/106106212 2. https://nptel.ac.in/courses/106106179 3. Data Science Methodology- Coursera - https://www.coursera.org/learn/datascience-methodology 4. Foundations of Data Science - edX - https://www.edx.org/course/foundationsof-data-science

Cryptography and Information Security

Course Code	20CS4501B	**Year**	III	**Semester**	I
Course Category	PEC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	-
Continuous Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the Basic concepts of security over the network.	**L2**
CO2	Apply various Key Management Techniques for secure key sharing.	**L3**
CO3	Analyze encryption algorithms and security protocols for their strengths and weaknesses	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√													
CO2						√	√							√
CO3						√	√		√	√				√

Syllabus		Mapped CO
Unit No.	Contents	
I	**Security Concepts:** The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A Model for Network Security. **Classical Encryption Techniques:** Substitution Techniques and Transposition Techniques.	**CO1**
II	**Block Ciphers and the Data Encryption Standard:** Traditional Block Cipher Structure, The Data Encryption Standard, Advanced Encryption Standard, Block Cipher operation.	**CO1, CO3**
III	**Public key cryptography:** Principles, RSA, Diffie-Hellman key exchange algorithm. **Cryptographic Hash Functions:** Secure Hash Algorithm (SHA-512), MACs Based on Hash Functions: HMAC, MACs Based on Block Ciphers: DAA and CMAC.	**CO1, CO3**
IV	**Key Management and Distribution:** Symmetric Key Distribution Using Symmetric Encryption, Symmetric Key Distribution Using Asymmetric Encryption, Distribution of Public Keys, X.509 Certificates. Public-Key Infrastructure, Kerberos	**CO1, CO2**
V	**Email Security:** S/MIME, Pretty Good Privacy. **IP Security**: IP Security Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange.	**CO1, CO3**

Learning Resources

Text Books

1. William Stallings. Cryptography and Network Security – Principles and Practice, Seventh edition, Pearson Education, 2017.

References

1. Cryptography and Network Security, Forouzan and Mukhopadhyay, Third edition, 2015, Mc Graw Hill.
2. Cryptography and Network Security, Atul Kahate, Third edition,Mc Graw Hill,2013.

e-Resources & other digital material

1. http://nptel.ac.in/courses/106105031/lecture, Dr. Debdeep Mukhopadhyay, IIT Kharagpur
2. https://www.coursera.org/learn/information-security-data
3. https://www.coursera.org/learn/number-theory-cryptography

Object Oriented Analysis and Design

Course Code	20CS4501C	**Year**	II	**Semester**	I
Course Category	PEC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Software Engineering
Continuous Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the basic concepts of object-oriented analysis and design.	**L2**
CO2	Apply UML Structural Modeling concepts to develop class diagrams for a given Application.	**L3**
CO3	Apply UML concepts for developing behavioral diagrams and Architectural diagrams.	**L3**
CO4	Analyze the given case study and develop appropriate UML diagrams	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√													
CO2	√													
CO3													√	
CO4		√				√			√	√				

Syllabus		Mapped CO
Unit No.	Contents	
I	**Introduction to UML**: Importance of modeling, principles of modeling, object oriented modeling, conceptual model of the UML, Architecture, and Software Development Life Cycle.	CO1
II	**Basic Structural Modeling:** Classes, Relationships, common Mechanisms, and diagrams. **Class & Object Diagrams:** Terms, concepts, modeling techniques for Class & Object Diagrams.	CO1,CO2,CO4
III	**Basic Behavioral Modeling:** Interactions, Interaction diagrams, Use cases, Use case Diagrams, Activity Diagrams.	CO1,CO3,CO4
IV	**Advanced Behavioral Modeling:** Events and signals, state machines, processes and Threads, time and space, state chart diagrams.	CO1,CO3,CO4
V	**Architectural Modeling:** Component, Deployment, Component diagrams and Deployment diagrams. **Case Study:** The Unified Library application.	CO1,CO2,CO3,CO4

Learning Resources

Text Books

1. The Unified Modeling Language User Guide, Grady Booch, James Rum Baugh, Ivar Jacobson, Second Edition, 2005, Pearson Education.

References

1. Object-Oriented Analysis and Design with Applications, Grady Booch Robert A. Maksimchuk Michael W. Engle Bobbi J. Young, Ph.D. Jim Conallen Kelli A. Houston ,Third Edition, 2007, Pearson Education.
2. UML 2 and the Unified Process: Practical Object-Oriented Analysis and Design, Jim Arlow, Ila Neustadt. 2nd edition, 2005, Addison-Wesley.
3. Applying UML Advanced Application, Rob Pooley, Pauline Wilcox , Elsevier,1st Edition 2003, Rob Pooley, Pauline Wilcox.

e-Resources & other digital material

1. http://nptel.ac.in/courses/122105022/27A.
2. http://www.csm.ornl.gov/~sheldon/public/sheldonf_auction.pdf

Artificial Intelligence

Course Code	20CS4501D	**Year**	III	**Semester**	I
Course Category	PEC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Basic Mathematics
Continuous Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the basic concepts of Artificial Intelligence.	**L2**
CO2	Apply the principles of AI in solutions that require problem solving, knowledge representation.	**L3**
CO3	Apply Planning and Learning for solving AI problems.	**L3**
CO4	Analyze a given problem and apply AI Techniques.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√													
CO2	√								√	√				
CO3													√	
CO4		√				√			√	√		√		

Syllabus		Mapped CO
Unit No.	**Contents**	
UNIT-1	**Introduction**: Definition of AI, Foundations of AI, Applications of AI. **Intelligent agents:** Agents and Environments, Structure of agents.	**CO1,CO4**
UNIT-2	**Problem Solving Techniques:** **Solving Problems by Searching:** Problem Solving Agents, Searching for Solutions. **Uninformed Search Strategies**- Breadth first search, depth first Search **Informed (Heuristic) Search Strategies**- Hill climbing, A* Algorithm, Alpha-Beta Pruning, Constraint Satisfaction Problem.	**CO2,CO4**
UNIT-3	**Knowledge Representation** **Logical Agents:** Knowledge Based Agents, Logic, Propositional logic, First order logic, Syntax and Semantics in First order Logic. **Inference in first order logic**: propositional vs. First order inference, Unification and Lifting, Forward chaining, Backward chaining, Resolution	**CO2,CO4**
UNIT-4	**Planning :** The Planning problem, planning with state space search, planning graphs, planning with propositional logic, Analysis of planning approaches, Hierarchical planning, conditional planning, Continuous and Multi Agent planning.	**CO3, CO4**
UNIT-5	**Learning:** Learning from Examples, Knowledge in Learning, Learning probabilistic Models, Reinforcement Learning.	**CO3, CO4**

Learning Resources

Text Books

1. Stuart Russell and Peter Norvig, ―Artificial Intelligence: A Modern Approach‖ , 3rd Edition, Prentice Hall.

References

1. A Classical Approach to Artificial Intelligence, M.C. Trivedi, Khanna Book Publishing, 2019.
2. Elaine Rich and Kevin Knight, ―Artificial Intelligence‖, Tata McGraw Hill
3. Saroj Kaushik, ―Artificial Intelligence‖, Cengage Learning India, 2011

e-Resources & other digital material

1. https://www.udemy.com/course/artificial-intelligence-az/
2. https://nptel.ac.in/courses/106105078
3. https://www.coursera.org/learn/introduction-to-ai

Database Management Systems Lab

Course Code	20CS3551	**Year**	III	**Semester**	I
Course Category	PCC	**Branch**	CSE	**Course Type**	Practical
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Problem Solving and Programming Lab
Continuous Internal Evaluation :	15	**Semester End Evaluation:**	35	**Total Marks:**	50

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Apply database management techniques to solve problems	**L3**
CO2	Conduct experiments by using modern tools like MYSQL, Oracle	**L3**
CO3	Develop an effective report based on various constructs implemented.	**L3**
CO4	Apply technical knowledge for a given problem and express with an effective oral communication.	**L3**
CO5	Analyze outputs of queries for a given problem	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													√	
CO2					√				√					
CO3										√				
CO4	√									√				
CO5			√											

Syllabus		
Expt. No.	**Contents**	**Mapped CO**
1	Introduction to MySQL Workbench. How to use MySql Workbench to run SQL Statements.	**CO1,CO2,CO3,CO4,CO5**
2	Examples on i) DDL Commands: CREATE , ALTER, DROP and TRUNCATE a Table ii) Implementation of Constraints PRIMARY KEY, FOREIGN KEY,CHECK,NOT NULL,UNIQUE.	**CO1,CO2,CO3,CO4,CO5**
3	Examples on i) DML Commands. INSERT, UPDATE and DELETE ii) DCL Commands: COMMIT , ROLLBACK and SAVEPOINT.	**CO1,CO2,CO3,CO4,CO5**
4	Examples on retrieving data from a single table using i) SELECT statement ii) SELECT statement with where clause(Comparison Operators, AND, OR, NOT, IN, BETWEEN,LIKE) iii) ORDER BY clause(sort by column name) iv) LIMIT clause	**CO1,CO2,CO3,CO4,CO5**
5	Examples of Functions in MySQL: String, Numeric, Date, Time and Other Functions.	**CO1,CO2,CO3,CO4,CO5**
6	Examples on Summary Queries: Queries using Aggregate functions, GROUP By and Having Clauses, ROLLUP Operator.	**CO1,CO2,CO3,CO4,CO5**
7	Examples on Inner join, outer join using USING and NATURAL Keywords	**CO1,CO2,CO3,CO4,CO5**
8	Examples on SUB/SUMMARY Queries Using IN, ANY, SOME, ALL , EXISTS and NOT EXISTS functions	**CO1,CO2,CO3,CO4,CO5**
9	Examples on i) Creating INDEXES and VIEWS ii) INSERT,DELETE and DROP on VIEWS	**CO1,CO2,CO3,CO4,CO5**
10	Examples on i) Create and Call STORED PROCEDURE (IN, OUT, INOUT Parameters), Drop a STORED PROCEDURE. ii) Create, call and Drop a FUNCTION. iii) Create and Drop a TRIGGER	**CO1,CO2,CO3,CO4,CO5**
11	Case Study Using Real world Database Applications	**CO1,CO2,CO3,CO4,CO5**

Learning Resources

Text Books

1. Murach"s MySQL by JOEL MURACH, Shroff Publishers & Distributors Pvt.Ltd, June 2012.

References

1. The Complete Reference MYSQL,VikramVaswani, 2017, McGrawHill Education.
2. Fundamentals of Database Systems, Ramez Elmasri,ShamkantB. Navathe, Seventh edition, Pearson.

Computer Networks Lab

Course Code	20CS3552	**Year**	III	**Semester**	I
Course Category	PCC	**Branch**	CSE	**Course Type**	Practical
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	-
Continuous Evaluation :	15	**Semester End Evaluation:**	35	**Total Marks:**	50

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Apply different design techniques for solving problems	**L3**
CO2	Implement programs as an individual on different modern tools/online platforms.	**L3**
CO3	Develop an effective report based on various programs implemented	**L3**
CO4	Apply technical knowledge for a given problem and express with an effective oral communication	**L3**
CO5	Analyze outputs using given constraints/test cases	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1														√
CO2					√				√					
CO3										√				
CO4	√									√				
CO5			√											

Syllabus		Mapped CO
Exp. No.	**Contents**	
1	Identify different types of Network devices/cables and practically implement the cross-wired cable and straight through cable using crimping tool.	**CO1, CO2, CO3, CO4, CO5**
2	Demonstrate connectivity of wired & wireless devices in Local Area Network using Hub, Switch and Router.	**CO1, CO2, CO3, CO4, CO5**
3	Experiment with the basic network commands like Ping, IPCONFIG, and Tracert in real networks.	**CO1, CO2, CO3, CO4, CO5**
4	Analyze Network Traffic Using Wireshark tool/ TCP dump tool	**CO1, CO2, CO3, CO4, CO5**
5	Implement Framing Mechanism using any Programming Language.	**CO1, CO2, CO3, CO4, CO5**
6	Implement Error Detection technique using any Programming Language.	**CO1, CO2, CO3, CO4, CO5**
7	Experiment with configuration of Host IP, Subnet Mask and Default Gateway of a device in LAN and establish Peer to Peer network connection.	**CO1, CO2, CO3, CO4, CO5**
8	Demonstrate Static and Dynamic Addressing Mechanisms.	**CO1, CO2, CO3, CO4, CO5**
9	Implement Unicast Routing Algorithm using any Programming Language	**CO1, CO2, CO3, CO4, CO5**
10	Demonstrate Network Address Translation (NAT)	**CO1, CO2, CO3, CO4, CO5**
11	Show the working of Application Layer Protocols - FTP, DNS, Telnet	**CO1, CO2, CO3, CO4, CO5**

Learning Resources
Text Books
1. Data Communications and Networking, Behrouz A. Forouzan, Fifth Edition, McGrawHill
References
1. Computer Networking A Top-Down Approach, James F. Kurose, Keith W. Ross, Sixth Edition, Pearson Education 2. Computer Networks - A Systems Approach, Larry L. Peterson, Bruce S. Davie, Fifth Edition, Morgan Kaufmann.

SOFT SKILLS

Course Code	20SS8551	**Year**	III	**Semester**	**I**
Course Category	Institutional Core	**Branch**	CSE	**Credits:**	2
Course Type	Theory			**Lecture-Tutorial- Practical:**	1-0-2
Prerequisites				**Continuous Evaluation:**	0
				Semester End Evaluation:	50
				Total Marks:	50

	Upon successful completion of the course, the student will be able to:		
Course Outcomes	**CO1**	**Develop** logical and **Analytical** skill set through Case Studies	L3
	CO2	**Proficient** in giving Presentations	L3
	CO3	**Understand** the corporate etiquette	L2
	CO4	**Develop** Competency in group discussion & Interviews	L3
	CO5	**Present** themselves with corporate readiness	L3

Contribution of Course Outcomes towards achievement of Program Outcomes		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
	CO1								√		√				
	CO2									√	√		√		
	CO3								√	√	√		√		
	CO4									√	√				
	CO5										√				

Course Content

UNIT-1	• Soft Skills- Need & Importance. Intra & Inter Personal Skills • Campus to Corporate- Employability Skills- Need of the hour • SWOT Analysis. • Attitude- Developing Professional & Positive Attitude • Perception – Importance of analytical thinking.	CO1, CO2, CO5.
UNIT-2	• Communication Skills – Need and Methods • Body-Language -I; How to interpret and understand other's body language • Body Language-II; How to improve one's own Body Language • Presentation Skills (Seminar Talk & Power Point Presentation)	CO1 CO2, CO4 CO5.
UNIT-3	• Goal Setting- Need & Importance • Magic of Team Work. • Leadership Qualities. • Six Thinking Hats.	CO1, CO3
UNIT-4	• Accountability towards Work. • Paragraph Writing – Descriptive and Analytical with illustrations • Email Writing • Work Etiquette	CO1, CO3, CO5.
UNIT-5	• Group Discussion (Open & Monitored) • Resume Preparation • Interview Skills • Mock Interviews	CO2, CO4, CO5
UNIT-6	• Vocabulary- Root Words (A representative Collection of 50)	

	• Vocabulary for Competitive Exams (A list of 500 high frequency Words) • Idioms & Phrases • Verbal Analogies • Correction of Sentences • Sentence Completion – Course of Action • Cloze Test • Reading Comprehension (Skimming, Scanning & tackling different kinds of questions) • Phrasal Collocations (Representative collection of 50 meanings along with sentential illustrations) • SWAR/ VERSANT Test	CO5.
Learning Resources		
Text Books	1. The ACE of Soft Skills by Gopalaswamy Ramesh & Mahadevan Ramesh –Pearson 2. Working with Emotional Intelligence - David Goleman. 3. Developing Communication Skills by Krishna Mohan and Meera Banerji; MacMillan India Ltd.,Delhi.	
Reference Books	1. Soft Skills: Meenakshi Raman. 2. Audio—Visuals / Hand Outs (Compiled/Created by T&P Cell, P.V.P.Siddhartha Institute of Technology), Board & Chalk and Interactive Sessions	

CONSTITUTION OF INDIA

Course Code	20MC1501	**Year**	III	**Semester**	I
Course Category	MC	**Branch**	CSE	**Course Type**	Theory
Credits	-	**L-T-P**	2-0-0	**Prerequisites**	--
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand about the historical background of Indian constitution and features	**L2**
CO2	Apply provisions of Citizenship Act and fundamental rights and responsibilities of the citizen	**L3**
CO3	Analyze the structure and function of union government	**L4**
CO4	Understand the knowledge about the legislature assembly of state government	**L2**
CO5	Analyze Indian statutory bodies and working of Election Commission	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						√		√	√					
CO2						√		√	√					
CO3						√		√	√					
CO4						√		√	√					
CO5						√		√	√					

Syllabus	
Unit No	**Contents**
I	**Introduction to Indian Constitution:** Constitutional history, constituent assembly, salient features of the constitution, significance of preamble, amending process of the constitution.
II	**Rights and Duties:** Citizenship, fundamental rights and directive principles, fundamental duties.
III	**Union Government:** President and vice president, election, removal and powers, Prime minister and council of ministers, parliament, supreme court, union, state relations, emergency provisions.

IV	**StateandLocalGovernments:**Governor,statelegislature,assemblyandcouncil, Chief minister and council of ministers, high court, rural and urban local governments with special reference to 73rd and 74th constitutional amendment acts.
V	**Other Constitutional and Statutory Bodies:** Comptroller and auditor general, election commission, finance commission, attorney general and advocate general, union public service commission(UPSC), state public service commissions(SPSCs), Tribunals, national human rights commission(NHRC).

Learning Resources
Text Books
1. J.C.Johari, Indian Government and Politics, Vishal Publications, Delhi,2009. 2. M.V.Pylee,IntroductiontotheConstitutionofIndia,5/e,VikasPublishingHouse,Mumbai,2007.
References
References: 1. D.D.Basu, Introduction to the Indian Constitution, 21/e,LexisNexis,Gurgaon,India,2011. 2. Subhas C.Kashyap, Our Constitution,2/e,National Book Trust India,NewDelhi,2013.

Internship

Course Code	20CS3581A	**Year**	III	**Semester**	I
Course Category		**Branch**	CSE	**Course Type**	Practical
Credits	1.5	**L-T-P**	0-0-0	**Prerequisites**	-
Continuous Evaluation :	-	**Semester End Evaluation:**	50	**Total Marks:**	50

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Apply domain knowledge during the course of internship.	**L3**
CO2	Demonstrate effective oral communication skills.	**L3**
CO3	Work as an individual or a team member in a collaborative environment.	**L3**
CO4	Exhibit integrity and ethical behavior while carrying out the internship	**L3**
CO5	Apply effective time management skills to complete the work within appropriate time.	**L3**
CO6	Develop an effective report based on the work completed during the internship.	**L3**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1													√	
CO2										√				
CO3									√					
CO4								√						
CO5											√			
CO6										√				

Advanced JAVA Programming

Course Code	20CS6522	**Year**	III	**Semester**	I
Course Category	Honors	**Branch**	CSE	**Course Type**	Integrated
Credits	4	**L-T-P**	3-0-2	**Prerequisites**	Java Programming
Continuous Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the advanced concepts of JAVA.	**L2**
CO2	Apply suitable generic classes for solving problems.	**L3**
CO3	Apply lambda expressions to provide the implementation of Functional interface for a given problem.	**L3**
CO4	Apply type hierarchy in collection framework of Java.	**L3**
CO5	Apply Regular expressions for pattern matching.	**L3**
CO6	Develop Java programs for a given problem	**L3**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√								√	√		√	√	√
CO2	√								√	√		√		
CO3	√								√	√		√		
CO4	√								√	√		√		
CO5	√								√	√		√		
CO6	√													

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Generics:** What are generics? A simple Generic Example, A generic class with two type parameters. The general form of a generic class, Bounded Types, Using wild card arguments, Creating generic method, Generic Interfaces, Some Generic Restrictions.	**CO1, CO2**
II	**Lambda Expressions:** Introducing Lambda Expressions, Block Lambda Expressions, Generic Functional Interfaces, Passing Lambda Expressions as Arguments, Lambda Expressions and Exceptions, Lambda Expressions and Variable Capture.	**CO1,CO3**
III	**Introduction To Collection Framework:** Collections Overview, **The Collection Interfaces**: The collection Interface, The List Interface, The Set Interface, The SortedSet Interface, The NavigableSet Interface, The Queue Interface, The Deque Interface. **The Collection Classes**: The ArrayList Class, The LinkedList class, The HashSet Class, The LinkedHashSet Class, The TreeSet Class, The PriorityQueue Class, The ArrayDeque Class, The EnumSet Class. Accessing a Collection Via an Iterator, Spliterators.	**CO1,CO4**
IV	**Developing Real World Applications Using Collections:** Storing user defined Classes in Collections, The Random Access Interface, Working with Maps, Comparators, The Collection Algorithms, and Arrays Class.	**CO1,CO4**
V	**More Utility Classe**s: Date, Calendar, Gregorian Calendar, TimeZone, SimpleTimeZone, Locale, Random. **Regular Expressions:** Regular Expression Processing: Pattern, Matcher, Regular Expression Syntax, Demonstrating Pattern Matching, Two Pattern - Matching Options, Exploring Regular Expressions, Reflection.	**CO1,CO5**

Unit No.	Experiment Details	Mapped CO's
1.	Demonstrate generic methods with suitable examples.	**CO1,CO2,CO3,CO4,CO5**
2.	Develop a generic class with suitable examples.	**CO1,CO2,CO3,CO4,CO5**
3.	Develop a generic program for ordered collection of elements.	**CO1,CO2,CO3,CO4,CO5**
4.	Implement an efficient data structure for storing and processing non-duplicate elements.	**CO1,CO2,CO3,CO4,CO5**
5.	Implement a Map-data structure that provides a quick look up to retrieve a value using a key.	**CO1,CO2,CO3,CO4,CO5**
6.	Use a data structure to prevent data corruption, when two or more threads running concurrently.	**CO1,CO2,CO3,CO4,CO5**
7.	Take a Java file that contains number of methods. Replace them with lambda expressions. How many lines did it save? Was the code easier to read? Were you able to use method references?	**CO1,CO2,CO3,CO4,CO5**
8.	Implement various applications using regular expressions.	**CO1,CO2,CO3,CO4,CO5**

Learning Resources	
Text Books	1. The Java Complete Reference, Herbert Scheldt, 10th edition, TMH Publications, 2018.
Reference Books	1. Introduction to java programming by Daniel Liang, 10th edition, Pearson. 2. Core Java: An Integrated Approach, New: Includes All Versions up-to Java 8, by R.Nageswara Rao, Dream-Tech Publishers. 3. Head First Java, Kathy Sierra, 2/e, Shroff Publishers, 2012.
e- Resources & other digital material	1. https://www.geeksforgeeks.org/data-structures/ 2. https://www.youtube.com/watch?v=0IAPZzGSbME 3. https://www.cs.usfca.edu/~galles/visualization/Algorithms.html 4. https://www.youtube.com/watch?v=S47aSEqm_0I&list=PLgj_VZKxRKrxgFyOutPJpoLFBaQMOpK- 5. https://www.geeksforgeeks.org/fundamentals-of-algorithms/ 6. https://www.javatpoint.com/collections-in-java

Computer Vision

Course Code:	20CS6522	**Year:**	III	**Semester:**	I
Course Category:	**Honors**	**Branch:**	CSE	**Course Type:**	Theory
Credits:	4	**L-T-P:**	4-0-0	**Prerequisites:**	Calculus &Linear Algebra, Probability Theory
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to:		
CO1	Understand the fundamental concepts of Computer Vision	**L2**
CO2	Apply Image transformation methods to view 2D and 3D images.	**L3**
CO3	Apply various Computer Vision techniques to develop applications	**L3**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO1	√													
CO2	√								√	√				√
CO3	√								√	√				√

Course Contents		
UNIT-1	Introduction: What is Computer Vision - Low-level, Mid-level, High-level, Overview of Diverse Computer Vision Applications: Optical character recognition (OCR), Machine inspection, 3D model building (photogrammetry), Medical imaging, Automotive safety, Motion capture, Surveillance, Fingerprint recognition and biometrics, Morphing, Video match move and stabilization, Face detection.	**CO1**
UNIT-2	Image Formation Models: Geometric primitives and transformations: The digital camera.	**CO1,CO2**
UNIT-3	Image Processing, Feature detection and matching: Points and patches, Edge detection, Edge linking, Lines. Regularization theory, Stereo vision, Structure from motion.	**CO1,CO3**
UNIT-4	Shape Representation and Segmentation: Snakes and active contours, Level set representations, Split and merge, Fourier, and wavelet, Mean shift and mode finding, Graph cut method.	**CO1,CO3**
UNIT-5	Object recognition: Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal component analysis, Shape priors for recognition	**CO1,CO3**

Learning Resources

Text Books

1. Computer Vision: Algorithms and Applications, R. Szeliski, 2011, Springer.
2. Computer Vision: A Modern Approach, D. Forsyth and J. Ponce, 2nd ed, 2011,Prentice Hall.

Reference Books

1. *Computer & Machine Vision*, E. R. Davies, 2012, Academic Press.
2. *Computer Vision*, Dana H. Ballard, Christopher M. Brown, 1st Edition, Prentice Hall 1982
3. Fundamentals of Computer Vision, Shah M., 1997.

e- Resources & other digital material

1. https://sites.usc.edu/iris-cvlab/
2. https://onlinecourses.nptel.ac.in/noc21_ee23/preview
3. https://nptel.ac.in/courses/106105216
4. https://nptel.ac.in/courses/108103174
5. https://www.coursera.org/learn/introduction-computer-vision-watson-opencv
6. https://www.coursera.org/projects/computer-vision-opencv-for-images

Time Series Analysis

Course Code:	20CS6522	**Year:**	III	**Semester:**	I
Course Category:	**Honors**	**Branch:**	CSE	**Course Type:**	Theory
Credits:	4	**L-T-P:**	4-0-0	**Prerequisites:**	-
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

COURSE OUTCOMES		
Upon successful completion of the course, Student will be able to		
CO1	Understand the fundamental concepts of Time Series Analysis.	**L2**
CO2	Apply suitable autoregressive processes on Stationary/ Non-stationary Time Series models for noise reduction.	**L3**
CO3	Apply Minimum Mean Square Error techniques for time series forecasting.	**L3**
CO4	Analyze the given scenario and use autoregressive models for time series prediction.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√													
CO2	√								√	√				√
CO3	√								√	√				√
CO4		√							√	√				√

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Fundamental Concepts** Stochastic Processes, The Autocovariance and Autocorrelation Functions, The Partial Autocorrelation Function, White Noise Processes, Estimation of the Mean, Autocovariances, and Autocorrelations: Sample Mean, Sample Autocovariance Function, Sample Autocorrelation Function, Sample Partial Autocorrelation Function; Moving Average and Autoregressive Representations of Time Series Processes.	**CO1, CO2**
II	**Stationary Time Series Models** Autoregressive Processes: The First-Order Autoregressive AR(1) Process, The Second-Order Autoregressive AR(2) Process, The General pth-Order Autoregressive AR(p) Process; Moving Average Processes: The First-Order Moving Average MA(1) Process, The Second-Order Moving Average MA(2) Process.	**CO1, CO2**
III	**Nonstationary Time Series Models** Nonstationarity in the Mean: Deterministic Trend Models, Stochastic Trend Models and Differencing; Autoregressive Integrated Moving Average (ARIMA) Models: The General ARIMA Model, The Random Walk Model, The ARIMA(0, 1, 1) or IMA(1,1) Model.	**CO1, CO2**
IV	**Forecasting** Introduction, Minimum Mean Square Error Forecasts: Minimum Mean Square Error Forecasts for ARMA Models, Minimum Mean Square Error Forecasts for ARIMA Models; Computation of Forecasts.	**CO1, CO3**
V	**Model Identification** Steps for Model Identification, Empirical Examples, The Inverse Autocorrelation Function (IACF), Extended Sample Autocorrelation Function and Other Identification Procedures: The Extended Sample Autocorrelation Function (ESACF), Other Identification Procedures.	**CO1, CO4**

Learning Resources

Text Books

1. Time Series Analysis, Wei, William WS. Second Edition, 2006, Pearson.

References

1. Time Series Analysis, Hamilton, James Douglas, 2020, Princeton university press.
2. Forecasting: Principles And Practice, Hyndman, Rob J., and George Athanasopoulos. 2018, OTexts.

e-Resources and other Digital Material

1. https://www.coursera.org/learn/practical-time-series-analysis
2. https://nptel.ac.in/courses/103106123
3. https://www.youtube.com/watch?v=Aw77aMLj9uM

Software Engineering

Course Code	20CS5502	**Year**	III	**Semester**	I
Course Category	Minor	**Branch**	Other Branches	**Course Type**	Theory
Credits	4	**L-T-P**	4-0-0	**Prerequisites**	-
Continuous Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the fundamentals of software engineering	**L2**
CO2	Apply various lifecycle activities for project development	**L3**
CO3	Apply Risk and Quality Management Strategies for project development	**L3**
CO4	Analyze the various requirements, design and Testing Techniques to select the appropriate techniques for the software project development.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√													
CO2	√								√	√			√	
CO3	√								√	√			√	
CO4		√							√	√			√	

Syllabus		Mapped CO
Unit No.	**Contents**	
I	Introduction to Software Engineering: The Nature of Software, The changing Nature of Software, Software Process, Software Engineering Practice, Software Development myths. Process models: Prescriptive process Models, Unified Process Model, **Agile process model**	**CO1,CO2**
II	Requirements engineering Requirements engineering, Establishing the Groundwork, Eliciting Requirements, Developing Use Cases, Building the Analysis Model, Negotiating requirements. Agile Requirements. Requirements Analysis: Scenario Based Modeling.	**CO1,CO2, CO4**
III	Design Engineering: Design process, Design concepts, The Design Model. Architectural design: Software architecture,Architectural Design, Agility and Architecture.	**CO1,CO2, CO4**
IV	Software Testing Strategies: A strategic approach to software testing, Test strategies for conventional software, Validation Testing, System Testing, The art of Debugging. Testing Conventional Applications: Software testing fundamentals, White-Box testing, Basis path testing, Control structure testing, Black-Box testing.	**CO1,CO2,CO4**
V	Risk management: Reactive vs. Proactive Risk strategies, software risks, Risk identification, Risk projection, Risk refinement, RMMM, RMMM Plan. Software Quality Assurance: Elements of SQA, SQA Tasks, Goals, and Metrics, Statistical Software Quality Assurance, Software Reliability, The ISO 9000 Quality Standards, The SQA Plan.	**CO1,CO3,CO4**

Learning Resources
Text Books
1. Software Engineering: A Practitioner's Approach, Roger S. Pressman, Bruce R. Maxim, Eighth edition, 2015, McGraw Hill, International Edition.
References
1. Robert C. Martin ,Agile Software Development, Principles, Patterns, and Practices Alan Apt Series (2011) 2. Software Engineering, Ian Sommerville, Seventh edition, 2004, Pearson,India 3. Software Engineering, K.K. Agarwal&Yogesh Singh, 2007, New Age International Publishers. 4. Software Engineering Principles and Practice, Waman S Jawadekar, 2004, McGraw Hill. 5. Fundamentals of Software Engineering, Rajib Mall, Fourth edition, 2009, PHI. 6. Succeeding with Agile : Software Development Using Scrum, Pearson (2010)
e-Resources & other digital material
1. https://onlinecourses.nptel.ac.in/noc20_cs68 2. https://thedigitalprojectmanager.com

Compiler Design

Course Code	20CS3601	**Year**	III	**Semester**	II
Course Category	PCC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Formal Languages and Automata Theory
Continuous Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the fundamental concepts of Compiler Design.	**L2**
CO2	Apply top-down parsing techniques to generate the parse trees.	**L3**
CO3	Apply bottom up parsing techniques to generate parse tree for the given grammar.	**L3**
CO4	Apply various code optimization techniques for intermediate code forms and Code Generation.	**L3**
CO5	Analyze the given grammar and apply suitable parsing techniques.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√													
CO2													√	
CO3													√	
CO4	√													
CO5		√							√	√				

	Course Content	**Mapped CO**
UNIT-1	**Language Processors:** Overview of language processing system: – preprocessors, compiler, assembler, linkers & loaders-difference between compiler and interpreter- structure of a compiler:–phases of a compiler. **Lexical Analysis:** - Role of Lexical Analysis – Input Buffering – Specification of Tokens – Recognition of Token – The Lexical Analyzer Generator (LEX).	**CO1**

UNIT-2	**Syntax Analysis:**–Introduction: - Role of a parser – Context Free Grammar – Writing Grammar. **Top Down Parsing**: – Recursive Descent Parsing-FIRST and FOLLOW - LL(1) Grammar – Non recursive Predictive Parsing- Error Recovery in Predictive Parsing.	**CO1,CO2, CO5**
UNIT-3	**Bottom up Parsing:** – Reductions – Handle Pruning - Shift Reduce Parsing – Conflicts During Shift–Reduce Parsing. **Introduction to simple LR Parsing:** – Why LR Parsers – Items and LR(0) Automaton- LR Parsing Algorithm– Construction of SLR parsing Tables.	**CO1,CO3, CO5**
UNIT-4	**More powerful LR parsers**: -Canonical LR(1) items, Constructing LR(1) sets of items, Canonical LR(1) parsing table – Construction of LALR Parsing tables. **Runtime Environment:** - Storage organization – Static versus Dynamic Storage Allocation, Stack allocation of Space –- Heap management **Intermediate code:** - Variants of Syntax Trees - Three address code – Quadruples - Triples - Indirect Triples.	**CO1,CO3, CO4, CO5**
UNIT-5	**Code Generation:-** **Basic Blocks and Flow Graphs**-Basic Blocks, Next use Information, Flow Graphs, Representation of Flow Graph, Loops. **Optimization of Basic Blocks:** – DAG representation of basic block. **Machine independent optimization** – Principle sources of Optimization- Causes of Redundancy, Running example: Quick Sort, Semantic Preserving transformations, Global common sub expressions, copy propagation, dead code elimination, code motion, induction variables, and reduction in strength. **Machine dependent code optimization**:- Peephole optimization – Register allocation and Assignment.	**CO1,CO4**
Learning Resources		
Text Books	1. Compilers: Principles, Techniques and Tools, Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Second Edition, Pearson Education.	
Reference Books	1. Modern Compiler Implementation in C- Andrew N. Appel, Cambridge University. 2. Principles of compiler design, V. Raghavan, Second edition, 2011, TMH. 3. Compiler Design, Muneeswaran K. First Edition, 2012, Oxford University Press.	
e-Resources & other digital material	1.http://www.nptel.iitm.ac.in/downloads/106108052/ 2.http://www.vssut.ac.in/lecture_notes/lecture1422914957.pdf	

Machine Learning

Course Code	20CS3602	**Year**	III	**Semester**	II
Course Category	PCC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Linear, algebra, Vectors Statistics and Probability, Data Structures and Algorithms
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the basic concepts of Machine Learning.	**L2**
CO2	Apply Supervised Learning algorithms for solving various problems	**L3**
CO3	Apply Unsupervised Learning and Reinforcement learning algorithms for solving various problems	**L3**
CO4	Analyze the given application and use suitable machine learning algorithm.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√													
CO2						√	√							√
CO3	√					√								
CO4		√				√	√		√	√				

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction**: Well Posed Learning Problems, Designing a Learning System, Perspectives and Issues in Machine Learning, Examples of Machine learning Applications. **Decision Tree Learning:** Decision Tree Representation, Appropriate Problems for Decision Tree Learning, Decision Tree Learning Algorithm.	**CO1**
II	**Artificial Neural Networks:** Neural Network Representation, Appropriate Problems for Neural Network Learning, Perceptions, Multilayer Networks and the Back Propagation Algorithm.	**CO1,CO2,CO4**
III	**Bayesian Learning**: Introduction, Bayes Theorem: An Example, Naïve Bayes Classifier, **Evaluating Hypothesis**: Motivation, Estimating hypothesis accuracy, **Measuring Classifier Accuracy, Ensemble Methods:** Bagging, Boosting.	**CO1,CO2,CO4**
IV	**Support Vector Machines:** The Case When the Data are Linearly Separable**,** The Case When the Data are Linearly Inseparable, **Instance Based Learning:** k-Nearest Neighbor Learning-Distance-Weighted Nearest Neighbor Algorithm, Case Based Reasoning	**CO1,CO2CO4**
V	**Unsupervised Learning:** Cluster Analysis, Partition Methods, Hierarchical Methods, Density based Methods, Grid based Methods. Measuring Clustering Quality.	**CO1,CO3CO4**

Learning Resources

Text Book

1. Machine Learning by Tom M. Mitchell, Indian Edition 2013, McGraw Hill Education.
2. Machine Learning Saikat Dutt,Subramanian Chandramouli, Amit Kumar Das, First Edition,2019,Pearson Education
3. Data Mining Concepts and Techniques,Jiawei Han,Micheline Kamber,Jian Pei,Third Edition,2012.

References

1. Introduction to Machine Learning by ETHEM ALPAYDIN, Fourth Edition, Prentice Hall of India, MIT Press, 2020.
2. C Bishop – Pattern Recognition and Machine Learning – Springer, 2006. Machine Learning, Anuradha Srinivasaraghavan , and Vincy Joseph ,Kindle Edition, September 2020, WILEY.
3. Machine Learning in Production:Developing and optimizing Data Science Workflows and Applications,Andrew Kelleher,Adam Kelleher, First Edition,2012,Pearson Education
4. Introduction to Data Mining, Pearson, Tan,Vipin Kumar,Michael Steinbach,Ninth Impression,2013.

e-Resources and other Digital Material

1. https://www.coursera.org/learn/machine-learning
2. https://nptel.ac.in/courses/106/106/106106139/

MERN Stack Development

Course Code	20CS3603	**Year**	III	**Semester**	II
Course Category	PCC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Programming with JAVA
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the fundamental concepts of web application development.	**L2**
CO2	Apply Node.JS restful APIs to Interact with HTTP services	**L3**
CO3	Apply React JS concepts to build an Application.	**L3**
CO4	Apply the concepts of Mongo DB to manipulate the Database	**L3**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√													
CO2			√						√	√			√	
CO3			√						√	√			√	
CO4			√						√	√			√	

Syllabus

Unit No.	**Contents**	**Mapped CO**
I	**Introducing the Node.js-to-Angular Stack**: Understanding the Basic Web Development Framework, Understanding the Node.js-to-Angular Stack Components, **JavaScript Primer** - Defining Variables, Understanding JavaScript Data Types, Using Operators, Implementing Looping, Creating Functions, Understanding Variable Scope, Using JavaScript Objects, Manipulating Strings, Working with Arrays, Adding Error Handling	**CO1**

II	**Getting Started with Node.js**: Understanding Node.js, Installing Node.js, Working with Node Packages, Creating a Node.js Application, Writing Data to the Console	**CO1, CO2**
III	**Implementing HTTP Services in Node.js**: Processing URLs, Understanding Request, Response, and Server Objects, Implementing HTTP Clients and Servers in Node.js, Implementing HTTPS Servers and Clients, **Implementing Express in Node.js**: Getting Started with Express, Configuring Routes, Using Request/Responses Objects	**CO1,CO2**
IV	**How React Works_**- Page Setup, React Elements, ReactDOM, React, components, React with JSX- React Elements as JSX, Babel, Recipes as JSX, React Fragments, Intro to webpack, **React State Management** - Building Forms, **Incorporating Data** - Requesting Data, **Virtualized Lists** - Creating a Fetch Hook, Creating a Fetch Component, Handling Multiple Requests, Memozing Values, React Router.	**CO1, CO3**
V	**Understanding NoSQL and MongoDB**: Why NoSQL?, Understanding MongoDB, MongoDB Data Types; **Getting Started with MongoDB and Node.js**: Building the MongoDB Environment, Accessing MongoDB from the Shell Client, MongoDB Shell commands and methods, Adding the MongoDB Driver to Node.js , Connecting to MongoDB from Node.js	**CO1,CO4**

Learning Resources
Text Books
1. Node.js, MongoDB and Angular Web Development by Brad Dayley, Brendan Dayley, Caleb Dayley, 2nd edition, Perason, ISBN-13: 978-0134655536, ISBN-10: 0134655532 2. Learning React Modern Patterns for Developing React Apps, 2nd Edition, Oreilly, ISBN: 978-1-492-D5172-5
References
1. Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node by Vasan Subramanian, Apress; 2nd ed. edition (13 May 2019), ISBN-10 : 1484243900, ISBN-13 : 978-1484243909 2. Mongodb, React, React Native Full-Stack Fundamentals and Beyond, by Eric Bush, Zaccheus Entertainment Publication, ISBN-10 : 0997196688, ISBN-13 : 978-0997196689 3. Quick Start Guide: Build web applications with MongoDB, Express.js, React, and Node by Eddy Wilson Iriarte Koroliova, Packt Publishing, ISBN-10: 1787281086, ISBN-13: 978-1787281080 4. Beginning Node.js, Express & MongoDB Development, by Greg Lim (Author), ISBN-10 : 9811480281 5. Beginning Node.js, Basarat Syed, APress, ISBN-10: 9781484201886
e-Resources and other Digital Material
1. www.w3schools.com 2. https://www.javatpoint.com/mean-stack-tutorial 3. https://www.linode.com/docs/guides/mean-stack-tutorial/

ECOLOGY AND ENVIRONMENT

Course Code	20CE2601A	Year	III	Semester	II
Course Category	Open Elective-II	Branch	CE	Course Type	Theory
Credits	3	L-T-P	3-0-0	Pre-requisites	Environmental Science
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes		
Upon successful completion of the course, the student will be able to:		
CO1	**Integrate** information related to structure and functions of ecological units.	L3
CO2	**Analyze** and communicate the concepts of environment.	L4
CO3	**Analyze** various environmental components and demonstrate using technology.	L4
CO4	**Analyze** and evaluate policies and frame works for welfare of environment & social sustainability.	L4
CO5	**Apply** system concepts for bio-monitoring environmental issues.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√						√					√		√
CO2	√					√	√							√
CO3	√						√	√						√
CO4	√						√							√
CO5	√					√	√					√		√

SYLLABUS		
Unit no.	**Contents**	**Mapped CO**
I	**ECOLOGY:** Introduction – Biosphere, scope, organization and significance. Ecosystem concept- structure &function, Factors affecting ecosystem. Evolution: Natural Selection and its ecological significance. Population parameters- growth regulation, relationships between organisms.	CO1 CO2
II	**NATURAL RESOURCES & MANAGEMENT:** Resource- Definition, category, concept and scarcity of resource. Forests & wild life- Global productivity & human activities (Exploitation). Land Resource- use pattern in India, soil & soil Conservation. Water resource- potentials and use with special reference to India, Concept of Integrated Water Resources Management (IWRM). Remote Sensing and GIS: Applications in conserving resources.	CO1 CO2
III	**ENVIRONMENTAL GEOSCIENCES & COMPUTER APPLICATIONS**: Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere. Scale of meteorology, pressure, temperature, atmospheric stability. Graphical representation of Data, creating Database tables.	CO3
IV	**ENVIRONMENTAL POLICY, EDUCATION AND ETHICS:** Important National policies: National environmental policy, 2006 & National agricultural policy etc. Legislation: Environment Protection Act, 1986.Environmental education: Goals and objectives of environmental education. Environment awareness and action: Role of NGOs in environmental awareness. Environmental movements in India- silent valley movement, Chipko movement, Narmada Bachao Andolan, Environmental movements in the West- Green Peace.	CO4
V	**ENVIRONMENTAL MONITORING AND MANAGEMENT:** Environmental impact analysis and EMP; Analytical approaches and instrumentation in environmental monitoring; Bio-monitoring of air pollution - plants as bio monitors; Bio monitoring of running water pollution. (Software's)Organic Farming and its ecological significance.	CO4 CO5

Learning Resources

Text Books

1. Singh, J.S; Singh, S.P. and Gupta S.R. Ecology, Environmental Science and Conservation. S. Chand & Company Pvt. Ltd. New Delhi. (2014)
2. Sharma, P.D. Ecology and Environment (11^{th} edition) Rastogi Publication, Meerut. (2011)
3. Bharucha, E. Text Book of Environmental Studies (2nd edition.). Universities Press, Hyderabad. (2013)

Reference Books

1. Nobel, B.J. and Wright, R.T. (1995) Environmental Science. Prentice Hall.
2. Agarwal, S.K. (1991) Pollution Ecology. Himanshu Publication, Udaipur.
3. S.V.S.Rana, Essentials of Ecology and Environmental Science, Prentice Hall India, New Delhi, 2011.

E-Resources & other digital material

1. http://nptel.ac.in

MATLAB PROGRAMMING

Course Code	20EC2601A	**Year**	III	**Semester**	II
Course Category	Open Elective II	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Outline the basic concepts of MATLAB. (L2)
CO2	Develop programs for scientific and mathematical problems. (L3)
CO3	Analyze an engineering system/Problem through graphical representation and numerical analysis. (L4)
CO4	Build optimized code for various applications in Engineering and Technology.(L3)

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	√				√					√			√	√
CO2	√				√					√			√	√
CO3		√			√					√			√	√
CO4	√				√					√			√	√

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction:** Starting MATLAB, Working in command window, Arithmetic operations, Display formats, Elementary Math Built-in functions, Defining scalar variables, useful commands for managing variables, Script files, Examples of MATLAB applications	CO1,CO2
II	**Creating arrays and Mathematical operations with arrays:** Creating 1-dimensional and 2- dimensional arrays, The Transpose operator, Array addressing, using a colon: in addressing arrays,	CO1, CO2, CO4

	Adding elements to existing variables, Deleting elements, Built in functions for handling arrays, Strings and strings as variables, Addition and Subtraction, Array Multiplication and Division, Element-by-Element operations, using arrays in MATLAB built-in math functions, Built in functions for analysing arrays, Generation of Random Numbers, Examples of MATLAB applications.	
III	**Two Dimensional and Three Dimensional Plots:** plot, fplot commands, Formatting a plot, plots with logarithmic axes, error bars, special graphics, Histograms, Polar plots, putting multiple plots on the same page, Multiple figure windows, Examples, Line plots, Mesh and surface plots, plots with special graphics, The view command, Examples of MATLAB applications	CO1,CO2, CO3,CO4
IV	**Programming in MATLAB:** Relational and Logical operators, conditional statements, The switch-case statement, Loops, Nested Loops and Nested conditional statements, The break and continue commands, creating a function file, structure of a function file, Local and Global variables, saving a function file, using a User- defined function, Examples of simple User-defined functions, comparison between script files and function files.	CO1,CO2, CO4
V	**Polynomial, Curve-fitting, Interpolation, Numerical Analysis**: Polynomials, curve fitting, Interpolation, The Basic fitting interface, Examples, solving equation of one variable, Finding minimum or maximum of a function, Numerical integration, ordinary differential equations.	CO2,CO3, CO4

--

Learning Resources
Text Books
1. Amos Gilat - MATLAB: An Introduction with applications – Wiley India Pvt. Ltd, 4th Ed., 2012. 2. Rudra Pratap - Getting started with MATLAB – Oxford University Press, 2010
Reference Books
1. Agam Kumar Tyagi - MATLAB and SIMULINK for Engineers – Oxford University Press, 2012.
e- Resources & other digital material
1. https://www.udemy.com/MATLAB/Online-Course 2. https://nptel.ac.in/courses/103/106/103106118

TV ENGINEERING

Course Code	20EC2601B	**Year**	III	**Semester**	II
Course Category	Open Elective-II	**Branch**	Common to All	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Compare Digital TV transmission standards and performance parameters (L2)
CO2	Analyse channel coding, errors, interferences and modulation techniques for Digital TV (L4)
CO3	Make use of RF amplifiers, modules and systems for Digital TV (L3)
CO4	Apply Transmission line principles for Digital TV (L3)
CO5	Test for a Digital TV Transmitter (L4)

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	√				√	√	√			√			√	√
CO2		√			√	√	√			√			√	√
CO3	√				√	√	√	√		√			√	√
CO4		√			√	√	√	√		√			√	√

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Digital Television Transmission Standards** ATSC terrestrial transmission standard, vestigial sideband modulation, DVB-T transmission standard, ISDB-T transmission standard, channel allocations, antenna height and power, MPEG-2 Performance Objectives for Digital Television: System noise, external noise sources, transmission errors, error vector magnitude, eye pattern, interference, co-channel interference, adjacent channel interference, analog to digital TV, transmitter requirements	CO1, CO2

II	Channel Coding and Modulation for Digital Television: Data synchronization, randomization/scrambling, forward error correction, interleaving, inner code, frame sync insertion, quadrature modulation, 8 VSB, bandwidth, error rate, COFDM, flexibility, bandwidth	CO1, CO2
III	**Transmitters for Digital Television**: Precorrection and equalization, up conversion, precise frequency control, RF amplifiers, solid-state transmitters, RF amplifier modules, power supplies, cooling, automatic gain or level control, ac distribution, transmitter control, tube transmitters, performance quality.	CO1, CO3
IV	**Transmission Line for Digital Television:** Fundamental parameters, efficiency, effect of VSWR, system AERP, rigid coaxial transmission lines, dissipation, attenuation, and power handling, higher-order modes, peak power rating, frequency response, standard lengths, corrugated coaxial cables, wind load, waveguide, bandwidth, waveguide attenuation, power rating, frequency response, size trade-offs, waveguide or coax pressurization	CO1, CO4
V	**Test and Measurement for Digital Television:** Power measurements, average power measurement, calorimetry, power meters, peak power measurement, measurement uncertainty, testing digital television transmitters.	CO1, CO5

Learning Resources
Text Books
1. Gerald w. Collins, Fundamentals of Digital Television Transmission, John Wiley, 2001. 2. R. R. Gulati, Modern Television Practice, Principles, Technology and servicing, 2nd Ed., New Age International Publishers, 2001.
Reference Books
1. John Arnold, Michael Frater, Mark Pickering, Digital Television Technology and Standards, John Wiley, 2007.
e- Resources & other digital material
1. https://www.youtube.com/watch?v=_nGnRvyHMEI&list=RDCMUCdlnqMpRrMcClK2fT6z8EEw&index=2 2. https://www.rfwireless-world.com/Tutorials/digital-television-DTV-basics.html

---

ENERGY MANAGEMENT

Course Code	20EE2601	**Year**	III	**Semester**	II
Course Category	Open Elective-II	**Branch**		**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Applied Physics, Basics of Electrical & Electronics Engineering
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

COURSE OUTCOMES	
After the completion of the course student will be able to	
CO1	**Understand** the fundamentals of energy scenario, energy management, Power Factor, Lighting and Energy Instrument, electric energy and economic aspects. **(L2)**
CO2	**Apply** the knowledge of energy scenario and energy management in electrical energy. **(L3)**
CO3	**Apply the** knowledge of Power Factor, Lighting and Energy Instruments use in electrical energy systems. **(L3)**
CO4	**Analyze the** methods to improve efficiency of electrical energy systems. **(L4)**
CO5	**Analyze** the economic aspects for energy conservation. **(L4)**
CO6	**Ability** to apply the various laws of energy management tools to measure the **basic** parameters and **submit a report.**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)														
CO/PO, PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1														
CO2	√					√	√						√	√
CO3	√		√		√								√	√
CO4		√										√	√	√
CO5		√		√							√		√	√
CO6									√	√		√	√	√

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Energy Scenario:** Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy	**CO1,CO2, CO6**

	scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.	
II	**Energy Management:** Introduction to energy management, principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting- Energy manger, Qualities and functions.	**CO1,CO2, CO6**
III	**Power Factor Improvement, Lighting and Energy Instruments :**Power factor –Pf with non-linear loads, effect of harmonics on power factor, power factor motor controllers - Good lighting system design and practice, lighting control ,lighting energy audit – List of Instruments for energy audit- wattmeter, data loggers, thermocouples, pyrometers, lux meters, tongue testers (working principle and measurement).	**CO1,CO3,CO6**
IV	**Electric Energy Management:** Introduction, Power Supply Effects of Unbalanced Voltages on the Performance of Motors, Electric motor Operating Loads, Determining Electric Motor Operating Loads, Power Meter, Slip Measurement, Electric Motor Efficiency, Sensitivity of Load to Motor RPM, Theoretical Power Consumption, Motor Efficiency Management, Motor Performance Management Process **Energy efficient transformers**: Introduction, transformer loading/efficiency analysis, case studies.	**CO1,CO4,CO6**
V	**Economic Aspects and Analysis:** Economics Analysis-Depreciation Methods, time value of money, internal rate of return, net present value method- Case Study- Energy efficient motors, replacement analysis, life cycle costing analysis- calculation of simple payback method, Case Study, Power factor correction, lighting - Applications of life cycle costing analysis, return on investment .	**CO1,CO5,CO6**

Learning Resources
Text Books:
1. Wayne C.Turner, ―*Energy management Hand book*, 8th Edition. John Wiley and son. 2. S.C. Tripathy, Electric ―*Energy Utilization and Conservation*, Tata McGraw Hill, 1991. 3. Arry C. White, Philip S. Schmidt, David R. Brown, ―*Industrial Energy Management Systems*, Hemisphere Publishing Corporation, New York, 1994
References:
1. John C. Andreas, ―*Energy efficient electric motors selection and application*‖. 2. Amit kumarTyagi, ―*Hand book on Energy Audit and Management*, TERI (Tata Energy Research Institute). 3. Paul W.O. Callaghan, ―*Energy Management*‖, McGraw hill Book Company. 4. Rakosh Das Begamudre, ―*Energy conversion systems*, 10th Edition, New Age International Publishers. 5. Industrial Energy Management: Principles and Applications by Giovanni Petrecea, Kluwer international series in engineering and computer science. Power electronics & power systems.1993. 6. W.R. Murphy & G.Mckey Butterworths, ―Energy Management, New Age International Publishers.
e- Resources & other digital material
1. www.bee-india.com

VALUE ENGINEERING

Course Code	20ME2601A	**Year**	III	**Semester**	II
Course Category	Open Elective	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		**Blooms Level**
Upon successful completion of the course, the student will be able to		
CO1	Understand the basic concepts, techniques and applications of value engineering	L2
CO2	Describe job plan of value engineering.	L2
CO3	Illustrate different value engineering techniques and versatility of value engineering.	L3
CO4	Illustrate the efforts of value engineering team during the process of value engineering	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (H:High (3), M: Medium(2), L:Low(1))

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1	√	√	√			√			√		√			√
CO 2	√	√	√			√			√		√			√
CO 3	√	√	√			√			√		√			√
CO 4	√	√	√			√			√		√			√

Syllabus

UNIT	**Content**	**Mapped CO**
I	**Introduction**: Value engineering (VE) concepts, advantages, applications, problem recognition, and role in productivity, criteria for comparison, element of choice. **Organization**: Level of value engineering in the organization, size and skill of VE staff, small plant, VE activity, unique and quantitative evaluation of ideas.	**CO1**
II	**Value engineering job plan**: Introduction, orientation, information phase, speculation phase analysis phase. Selection and Evaluation of value engineering Projects, Project selection, methods selection, value standards, application of value engineering methodology.	**CO1,CO2**
III	**Value engineering techniques** : Selecting products and operation for value engineering action, value engineering programmes, determining and evaluating function(s) assigning rupee equivalents, developing alternate means to required functions, decision making for optimum	**CO1,CO3**

	alternative, use of decision matrix, queuing theory and Monte Carlo method make or buy, measuring profits, reporting results, Follow up, Use of advanced technique like Function Analysis System.	
IV	**Versatility of value engineering**: Value engineering operation in maintenance and repair activities, value engineering in non hardware projects. **Initiating a value engineering programme**: Introduction, training plan, career development for value engineering specialties.	**CO1,CO3**
V	**Value engineering level of effort**: Value engineering team, co-coordinator, designer, different services, definitions, construction management contracts, value engineering case studies.	**CO1,CO4**

Learning Resources
Text books:
1. Anil Kumar Mukhopadhyaya, “Value Engineering: Concepts Techniques and applications”, SAGE Publications 2010.
Reference books
1. Alphonse Dell’Isola, “Value Engineering: Practical Applications for Design, Construction, Maintenance & Operations”, R S Means Co., 1997. 2. Richard Park, “Value Engineering: A Plan for Invention”, St. Lucie Press, 1999. 3. Del L. Younker, “Value Engineering analysis and methodology”, Marcel Dekker Inc, New York, 2004. 4. Miles, L.D., “Techniques of Value Analysis and Engineering”, McGraw Hill second Edition, 1989. 5. Khanna, O.P., “Industrial Engineering and Management”, Dhanpat Rai & Sons, 1993. 6. Anil Kumar Mukhopadhyaya, “Value Engineering Mastermind: From concept to Value Engineering Certification”, SAGE Publications, 2003

HUMAN FACTORS IN ENGINEERING

Course Code	20ME2601B	Year	III	Semester	II
Course Category	Open Elective	Branch	ME	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	Nil
Continuous Internal Evaluation	30	Semester End Evaluation	70	Total Marks	100

Course Outcomes: Upon successful completion of the course, the student will be able to

CO	Statement	Skill	BTL	Units
CO1	Discuss the fundamentals of Human factors, Physical work, Anthropometry, Ergonomics, Machine controls, Seating design, Colour - Light, Temperature - Humidity –Illuminations and Measurement of sound.	Understand	L2	1,2,3,4,5
CO2	Identify the role of Anthropometry and Ergonomics in product design.	Apply	L3	2
CO3	Choose the effective seating design and Machine controls for improvement of human workplace.	Apply	L3	3
CO4	Represent the importance of colour and light, Temperature - Humidity – Illumination, Measurement of sound in human workplace.	Apply	L3	4,5

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (H: High(3), M: Medium(2), L:Low(1))														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√		√			√			√			√	√	√
CO2	√		√			√			√			√	√	√
CO3	√		√			√			√			√	√	√
CO4	√		√			√			√			√	√	√

Syllabus		
UNIT	**Content**	**Mapped CO**
I	**Fundamentals of Human Factors Engineering**: Human Biological, Ergonomic and psychological capabilities and limitations, Concepts of human factors engineering and Ergonomics, Man-Machine system and Design philosophy. **Physical work and energy expenditure**: Manual lifting, Work posture, Repetitive motion, Provision of energy for muscular work, Heat stress, Role of oxygen physical exertion, Measurement of energy expenditure, Respiration, Pulse rate and blood pressure during physical work, Physical work capacity and its evaluation.	**CO1**
II	**Anthropometry**: Physical dimensions of the human body as a working machine, Motion size relationships, Static and dynamic anthropometry, Anthropometric design principles, Using anthropometric measures for industrial design.	**CO1, CO2**

	Ergonomics and product design: Ergonomics in automated systems, Expert systems for ergonomic design, Anthropometric data and its application in ergonomic design, Limitations of anthropometric data, Use of computerized database.	
III	**Machine controls:** Improvement of human work place through controls, Displays and Controls, Shapes and sizes of various controls and displays, Multiple display and control situations, Design of major controls in automobiles and machine tools, Principles of hand tool design. **Work place and seating design**: Design of office furniture, Redesign of instruments, Work process: Duration of rest periods, Design of visual displays, Design for shift work.	**CO1, CO3**
IV	**Color and light:** Color and the eye, Color consistency, Color terms, Reactions to color and color continuation, Color on engineering equipments. **Temperature-Humidity-Illumination and Contrast**: Use of Photometers, Recommended illumination levels, the ageing eye, Use of indirect (Reflected) lighting, Cost efficiency of illumination. Special purpose lighting for illumination and quality control.	**CO1, CO4**
V	**Measurement of sound**: Noise exposure and hearing loss, Hearing protectors, Analysis and reduction of noise, Effects of noise, Performance annoyance of noise and interface with communication, Sources of vibration and performance effect of vibration.	**CO1, CO4**

Learning Recourse(s)
Text Book(s)
1. . M. S. Sanders and E. J. McCormick, Human Factors in Engineering Design, VII Edition, McGraw Hill International, 1993.
Reference books
1. P. V. Karpovich and W. E. Sinning, Physiology of Muscular Activity", VII Edition, Saunders (W.B.) Co Ltd., 1971. 2. Applied Ergonomics Handbook, I.P.C. Science and Technology Press Limited, 1974. 3. M. Helander, A Guide to the Ergonomics of Manufacturing, II Edition, CRC Press, 1997. 4. K. H. E. Kroemer, H. B. Kroemer, K. E. Kroemer Elbert, Ergonomics: How to design for ease and efficiency, II Edition, Pearson Publications, 2001.

Design Patterns

Course Code	20CS4601A	Year	III	Semester	II
Course Category	PEC	Branch	CSE	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	Object Oriented and Analysis of Design, Software Engineering
Continuous Evaluation :	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the fundamental concepts of Design patterns for problems	**L2**
CO2	Apply creational patterns in software design for object creation	**L3**
CO3	Apply structural patterns to assemble objects and classes in software design	**L3**
CO4	Apply behavioral patterns to identify common communication patterns among objects in software design	**L3**
CO5	Analyze design solutions by using suitable patterns for given case studies.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√													
CO2	√													
CO3													√	
CO4													√	
CO5		√				√			√	√				

Unit No.	Syllabus Contents	Mapped CO
I	**Introduction:** What Is a Design Pattern? Design Patterns in Smalltalk MVC, Describing Design Patterns, The Catalog of Design Patterns, Organizing the Catalog, How Design Patterns Solve Design Problems, How to Select a Design Pattern, How to Use a Design Pattern.	**CO1**
II	**Creational Patterns:**stract Factory, Builder, Factory Method, Prototype, Singleton.	**O2,CO5**
III	**Structural Patterns:**Adapter, Bridge, Composite, Decorator, Façade, Flyweight, Proxy.	**CO1, CO3,CO5**
IV	**Behavioral Patterns:** Chain of Responsibility, Command, Interpreter, Iterator, Mediator, Memento, Observer, Strategy, Template Method, Visitor. Conclusion: What to Expect from Design Patterns, The Pattern Community.	**CO1, CO4,CO5**
V	**A Case Study:** Designing a Document Editor: Design Problems, Document Structure, Formatting, Embellishing the User Interface, Supporting Multiple Look-and-Feel Standards, Supporting Multiple Window Systems, User Operations, Spelling Checking and Hyphenation.	**CO1,CO2, CO3,CO4,CO5**

Learning Resources
Text Books
1. Design Patterns Elements of Reusable Object-Oriented Software, Erich Gamma, First edition, 1995, Pearson Education.
References
1. Head First Design Patterns, by Eric Freeman, Elisabeth Robson, First Edition, 2004, O'Reilly Media, Inc. 2. Peeling Design Patterns, by Prof. Meda Srinivasa Rao, Narasimha Karumanchi, First Edition, 2017, Career Monk Publications. 3. JAVA Enterprise Design Patterns Vol-III, Mark Grand , 2001, Wiley Dream Tech.
e-Resources & other digital material
1. https://www.coursera.org/learn/design-patterns. 2. https://www.coursera.org/learn/uml. 3. https://www.coursera.org/learn/object-oriented-design. 4.https://sourcemaking.com/design-patterns-ebo

Software Defined Networks

Course Code	20CS4601B	**Year**	III	**Semester**	II
Course Category	PEC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Computer Networks
Continuous Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the concepts of Software Defined Networks	**L2**
CO2	Apply various SDN Principles with different Architectures	**L3**
CO3	Apply concepts of Virtualization, Framework solutions on Data Centres	**L3**
CO4	Analyse a given scenario and implement Social Defined Networks	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	√													
CO 2	√													
CO 3													√	
CO 4		√								√		√		

Syllabus		Mapped CO
Unit No.	Contents	
I	**INTRODUCTION:** History of Software Defined Networking (SDN) – Modern Data Center – Traditional Switch Architecture – Why SDN – Evolution of SDN – How SDN Works – Centralized and Distributed Control and Date Planes	**CO1**
II	**OPEN FLOW & SDN CONTROLLERS:** Open Flow Specification – Drawbacks of Open SDN, SDN via APIs, SDN via Hypervisor- Based Overlays – SDN via Opening up the Device – SDN Controllers – General Concept	**CO1, CO2, CO4**
III	**DATA CENTERS:** Multitenant and Virtualized Multitenant Data Center – SDN Solutions for the Data Center Network – VLANs – EVPN – VxLAN – NVGRE	**CO1, CO2, CO4**
IV	**SDN PROGRAMMING:** Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs – Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications	**CO1, CO3, CO4**
V	**SDN:** Juniper SDN Framework – IETF SDN Framework – Open Daylight Controller – Floodlight Controller – Bandwidth Calendaring – Data Center Orchestration	**CO1, CO3, CO4**

Learning Resources
Text Books
1. Paul Goransson and Chuck Black, ―Software Defined Networks: A Comprehensive Approach, First Edition, Morgan Kaufmann, 2014. 2. Thomas D. Nadeau, Ken Gray, ―SDN: Software Defined Networks, O'Reilly Media, 2013.
References
1. Siamak Azodolmolky, ―Software Defined Networking with Open Flow, Packet Publishing, 2013 2. Vivek Tiwari, ―SDN and Open Flow for Beginners‖, Amazon Digital Services, Inc., 2013 3. Fei Hu, Editor, ―Network Innovation through Open Flow and SDN: Principles and Design, CRC Press, 2014.
e-Resources & other digital material
1. https://www.coursera.org/learn/sdn. **2.** https://www.udemy.com/course/sdn-openflow-nfv-introduction/ **3.** https://www.coursera.org/learn/network-virtual.

Block Chain Technology

Course Code	20CS4601C	**Year**	III	**Semester**	II
Course Category	PEC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	-
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the key dimensions of Block chain Technology	**L2**
CO2	Apply the principles of Block chain for a given application.	**L3**
CO3	Apply the features of Ethereum and Hyperledger to develop various applications	**L3**
CO4	Analyze the given scenario and design a block chain based solution.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√													
CO2														√
CO3														√
CO4		√							√	√				

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Block chain 101:** Distributed systems, History of Block chain and bitcoin, Introduction to Block chain, Consensus, CAP theorem and Block chain.	**CO1,CO2**
II	**Decentralization:** Decentralization using Block chain, Methods of decentralization, Routes to decentralization, Block chain and full ecosystem decentralization, pertinent Terminology.	**CO1,CO2,CO4**
III	**Cryptography and Technical Foundations:** Cryptographic primitives, Asymmetric cryptography, Cryptographic constructs and Block chain technology **Introducing Bitcoin**: Overview, Cryptographic keys, transactions, Blockchain, Mining.	**CO1,CO2,CO4**
IV	**Ethereum 101:**Overview, The Ethereum Network, Components of the Ethereum ecosystem, The Ethereum Virtual Machine. **Smart Contracts:** Definition, Ricardian Contracts, Smart Contract Templates, Oracles, Deploying Smart Contracts	**CO1,CO3,CO4**
V	**Hyperledger:** Overview, Hyperledger Reference Architecture, Hyperledger fabric. Blockchain-Outside of Currencies: Internet of Things, Government, Health, Finance, Media.	**CO1,CO3,CO4**

Learning Resources
Text Book
1.Mastering Block chain - Distributed ledgers, decentralization and smart contracts explained, Imran Bashir, Third Edition, Packt Publishing Ltd.
References
1. Bitcoin and Cryptocurrency Technologies, Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Princeton University, 2016. **2.** Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, First Edition, 2014, O'Reilly Media.
e-Resources and other Digital Material
1. https://www.coursera.org/specializations/blockchain 2. https://nptel.ac.in/courses/106105184/

Computer Graphics

Course Code	20CS4601D	**Year**	III	**Semester**	II
Course Category	PEC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	-
Continuous Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand graphics applications, architectures and openGL program structure	**L2**
CO2	Apply openGL functions to design interactive programs	**L3**
CO3	Apply basic transformations on objects	**L3**
CO4	Apply line and polygon clipping algorithms	**L3**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√													
CO2										√			√	
CO3	√									√				
CO4	√								√	√				

Syllabus		Mapped CO
Unit No.	Contents	
I	Introduction: Applications of computer graphics; A graphics system; Images: Physical and synthetic; Imaging systems; the synthetic camera model; the programmer‟s interface; Graphics architectures. Graphics Programming: The Sierpinski gasket; Programming two- dimensional applications. The OpenGL API; Primitives and attributes; Color; Viewing; Control functions; The Gasket program.	CO1,CO2
II	Input and Interaction: Interaction; Input devices; Clients and servers; Display lists; Display lists and modeling; Programming event-driven input; Menus; Picking; Animating interactive programs; Logic operations.	CO1,CO2
III	Geometric Objects and Transformations: Scalars, points, and vectors; Three-dimensional primitives; Coordinate systems and frames; Modeling a colored cube; Affine transformations; Rotation, translation and scaling. Transformations in homogeneous coordinates; Concatenation of transformations; OpenGL transformation matrices.	CO1, CO3
IV	Viewing: Classical and computer viewing; Viewing with a computer; Positioning of the camera; Simple projections; Projections in OpenGL; Parallel-projection matrices; Perspective projection matrices.	CO1,CO3
V	Implementation: Basic implementation strategies; Clipping; Cohen-Sutherland Line-segment clipping; Polygon clipping; Clipping of other primitives; Clipping in three dimensions; Rasterization; Bresenham‟s algorithm; Polygon rasterization;	CO1,CO4

Learning Resources
Text Books
1. Interactive Computer Graphics A Top-Down Approach with OpenGL, Edward Angel, 5th Edition, Pearson, 2009. 2. Computer Graphics through OpenGL: From Theory to Experiments, Sumantha Guha, Chapman and Hall/CRC, 2011 (For OpenGL and related examples).
References
1. Computer Graphics with OpenGL, Hearn & Baker, 3rd Edition, Pearson 2004. 2. Computer Graphics Using OpenGL, F.S. Hill, Jr, and M. Kelley, Jr., 3rd Edition, Pearson/PHI, 2009.

Compiler Design Lab

Course Code	20CS3651	**Year**	III	**Semester**	II
Course Category	PCC	**Branch**	CSE	**Course Type**	Practical
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Programming Language
Continuous Internal Evaluation :	15	**Semester End Evaluation:**	35	**Total Marks:**	50

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Apply C, LEX and YACC programming to write a solution for the phases of compiler problems.	**L3**
CO2	Implement programs as an individual on different IDEs.	**L3**
CO3	Develop an effective report based on various programs implemented.	**L3**
CO4	Apply technical knowledge for a given problem and express with an effective oral communication.	**L3**
CO5	Analyze outputs generated by executing C, LEX and YACC programs for different test cases.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1													√	
CO2					√				√					
CO3										√				
CO4	√									√				
CO5			√											

Syllabus		
Expt. No.	**Contents**	**Mapped CO**
1	Design a Lexical analyzer for the given language. The lexical analyzer should ignore redundant spaces, tabs and new lines. It should also ignore comments. Although the syntax specification states that identifiers can be arbitrarily long, you may restrict the length to some reasonable value.	**CO1,CO2,CO3, CO4,CO5**
2	(a) Implement the lexical analyzer using LEX program for the regular expression RE‘s: a(a+b)* (b) Implement the LEX program to implement RE‘s: (a+b)*abb(a+b)*	**CO1,CO2,CO3, CO4,CO5**
3	(a) Implement the lexical analyzer using JLEX, FLEX or LEX or other lexical analyzer generating stools. (b) Implement the lexical analyzer Program to count no of +ve and –ve integers using LEX	**CO1,CO2,CO3, CO4,CO5**
4	(a) Implement the lexical analyzer Program to count the number of vowels and consonants in a given string. (b) Implement the lexical analyzer Program to count the number of characters, words, spaces, end of lines in a given input file.	**CO1,CO2,CO3, CO4,CO5**
5	Implement a _C‘ program to calculate First and Follow sets of given grammar	**CO1,CO2,CO3, CO4,CO5**
6	Design Predictive parser for the given language.	**CO1,CO2,CO3, CO4,CO5**
7	Implementation of Shift Reduce Parsing Algorithm.	**CO1,CO2,CO3, CO4,CO5**
8	Design LALR bottom up parser for the given language. (Implementation of calculator using YACC)	**CO1,CO2,CO3, CO4,CO5**
9	Convert the BNF rules into YACC form and write code to generate abstract syntax tree.	**CO1,CO2,CO3, CO4,CO5**
10	Implement a Machine Code for a given Intermediate Code.	**CO1,CO2,CO3, CO4,CO5**

Learning Resources

Text Books

1. Compilers: Principles, Techniques and Tools: 2nd Edition, Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ulman; 2nd Edition , Pearson Education.
2. Modern Compiler Implementation in C- Andrew N. Appel, Cambridge University Press.

References

1. lex &yacc – John R. Levine, Tony Mason, Doug Brown, O‟reilly
2. Modern Compiler Design- Dick Grune, Henry E. Bal, Cariel T. H. Jacobs, Wiley dreamtech.
3. Engineering a Compiler-Cooper & Linda, Elsevier.
4. Compiler Construction, Louden, Thomson.
5. Principles of compiler design, V. Raghavan, 2nd ed, TMH,2011.

e-Resources and other Digital Material

1. http://www.nptel.iitm.ac.in/downloads/106108052/

Machine Learning Lab

Course Code	20CS3652	**Year**	III	**Semester**	II
Course Category	PCC	**Branch**	CSE	**Course Type**	Practical
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Programming for problem solving, Java Programming, Python Programming
Continuous Internal Evaluation :	15	**Semester End Evaluation:**	35	**Total Marks:**	50

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Apply various preprocessing techniques and Machine Learning methods on different datasets for a given problem.	**L3**
CO2	Implement various experiments in Jupyter Notebook Environment and Colab.	**L3**
CO3	Develop an effective report based on various learning methods implemented.	**L3**
CO4	Apply technical knowledge for a given scenario and express with an effective oral communication	**L3**
CO5	Analyze the outputs and visualizations generated for different datasets.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1		√												√
CO2					√	√								
CO3										√				
CO4									√		√			
CO5			√			√								

Description (If any):

1. The programs can be implemented in either Python in Anaconda Software Jupyter Note book Environment or Co Lab.

2. Data sets can be taken from standard repositories (https://archive.ics.uci.edu/ml/datasets.html) or constructed by the students.

Syllabus		
Expt. No.	**Contents**	**Mapped CO**
1	Anaconda Software Installation and introduction to Jupyter and Co Lab.	**CO1,CO2,CO3,CO4, CO5**
2	Apply Data pre-processing techniques.	**CO1,CO2,CO3,CO4, CO5**
3	Implement ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.	**CO1,CO2,CO3,CO4, CO5**
4	Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.	**CO1,CO2,CO3,CO4, CO5**
5	Implement naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	**CO1,CO2,CO3,CO4, CO5**
6	Implement k-nearest neighbours classification using python.	**CO1,CO2,CO3,CO4, CO5**
7	Implementation of K-means Clustering algorithm.	**CO1,CO2,CO3,CO4, CO5**
8	Implementation of DBSCAN Clustering algorithm.	**CO1,CO2,CO3,CO4, CO5**
9	Implementation of hierarchical agglomerative clustering algorithm	**CO1,CO2,CO3,CO4, CO5**

Learning Resources

Text Books

1. Machine Learning using Python , U Dinesh Kumar and Manaranjan Pradhan, John Wiley & Sons
2. Machine Learning with Python for Everyone, Mark E.Fenner, First Edition, 2020,Pearson.
3. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, 2012, MIT Press

References

1. Artificial Intelligence: A Modern Approach, Stuart Russell and Norvig, Third Edition, 2015,
2. C Bishop – Pattern Recognition and Machine Learning – Springer, 2006. Machine Learning, Anuradha Srinivasaraghavan , and Vincy Joseph ,Kindle Edition, September 2020, WILEY.
3. Introduction to Machine Learning by ETHEM ALPAYDIN, Fourth Edition, Prentice Hall of India, MIT Press, 2020.

e-Resources and other Digital Material

1. https://www.coursera.org/learn/machine-learning
2. https://github.com/atinesh-s/Coursera-Machine-Learning-Stanford

MERN Stack Development Lab

Course Code	20CS3653	**Year**	III	**Semester**	II
Course Category	PCC	**Branch**	CSE	**Course Type**	Practical
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	Programming with JAVA
Continuous Internal Evaluation :	15	**Semester End Evaluation:**	35	**Total Marks:**	50

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Apply MERN technologies to develop web applications.	**L3**
CO2	Implement various applications as an individual or team member	**L3**
CO3	Develop an effective report based on various programs implemented	**L3**
CO4	Apply technical knowledge for a given problem and express with an effective oral communication	**L3**
CO5	Analyze outputs of web based applications	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1														√
CO2					√				√					
CO3										√				
CO4						√				√				
CO5		√												

Syllabus		
Expt. No.	**Contents**	**Mapped CO**
1	Demonstration of const, let, string templates, callbacks, arrow functions, class, class-properties, methods using Java Script.	**CO1,CO2,CO3, CO4,CO5**
2	Use of global object, Variables, Standard input and standard output in Node JS to build application.	**CO1,CO2,CO3, CO4,CO5**
3	Develop Node JS Application and Implement HTTP Services in Node JS (Request and Response)	**CO1,CO2,CO3, CO4,CO5**
4	Implement React Elements and Components	**CO1,CO2,CO3, CO4,CO5**
5	Develop a Single Page Application (SPA)	**CO1,CO2,CO3, CO4,CO5**
6	Reading and writing to MongoDb database using APIs	**CO1,CO2,CO3, CO4,CO5**
7	Developing a simple CRUD application using the MERN stack	**CO1,CO2,CO3, CO4,CO5**
8	Case Studies: Build web applications based on the **choice of student/faculty**	**CO1,CO2,CO3, CO4,CO5**

Learning Resources

Text Books

1. Node.js, MongoDB and Angular Web Development by Brad Dayley, Brendan Dayley, Caleb Dayley, 2nd edition, Perason, ISBN-13: 978-0134655536, ISBN-10: 0134655532
2. Learning React Modern Patterns for Developing React Apps, 2nd Edition, Oreilly, ISBN: 978-1-492-D5172-5

References

1. Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node by Vasan Subramanian, Apress; 2nd ed. edition (13 May 2019), ISBN-10 : 1484243900, ISBN-13 : 978-1484243909
2. Mongodb, React, React Native Full-Stack Fundamentals and Beyond, by Eric Bush, Zaccheus Entertainment Publication, ISBN-10 : 0997196688, ISBN-13 : 978-0997196689
3. Quick Start Guide: Build web applications with MongoDB, Express.js, React, and Node by Eddy Wilson Iriarte Koroliova, Packt Publishing, ISBN-10: 1787281086, ISBN-13: 978-1787281080
4. Beginning Node.js, Express & MongoDB Development, by Greg Lim (Author), ISBN-10 : 9811480281
5. Beginning Node.js, Basarat Syed, APress, ISBN-10: 9781484201886
6. Learning React Functional Web Development with React and Redux by Alex Banks and Eve Porcello, Published by O'Reilly Media, Inc. , ISBN-10 : 9352135636, ISBN-13 : 978- 9352135639
7. React Quickly: Painless web apps with React, JSX, Redux, and GraphQL, by Azat Mardan, Published by Manning Publications, Manning Publications, ISBN-10 : 1617293342, ISBN-13 : 978-1617293344

e-Resources and other Digital Material
4. www.w3schools.com 5. https://www.javatpoint.com/mean-stack-tutorial 6. https://www.linode.com/docs/guides/mean-stack-tutorial/ 7. https://blog.logrocket.com/mern-stack-tutorial/

Mobile App Development

Course Code	20SA8651	**Year**	III	**Semester**	II
Course Category	SOC	**Branch**	CSE	**Course Type**	Practical
Credits	2	**L-T-P**	1-0-2	**Prerequisites**	Programming with Java, DBMS, Advanced Java and Web Technologies
Continuous Internal Evaluation :	--	**Semester End Evaluation:**	50	**Total Marks:**	50

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Apply the basic of android to develop android applications	**L3**
CO2	Develop various applications as an individual or team	**L3**
CO3	Develop an effective report based on various programs implemented	**L3**
CO4	Apply technical knowledge for a given problem and express with an effective oral communication	**L3**
CO5	Analyze outputs generated using android application	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		√											√	
CO2					√				√					
CO3										√				
CO4									√		√			
CO5			√			√								

Expt. No.	Course Content	Mapped CO
1	Build mobile application based on the concept activity life cycle with Custom Toast.	**CO1, CO2, CO3, CO4, CO5**
2	Build mobile application using different layouts (use any 3 layouts)	**CO1, CO2, CO3, CO4, CO5**
3	Build mobile application using different dialogs (use any 2 dialogs)	**CO1, CO2, CO3, CO4, CO5**
4	Build mobile application using Recycler View	**CO1, CO2, CO3, CO4, CO5**
5	Build mobile application to switch from one activity to another using Intent.	**CO1, CO2, CO3, CO4, CO5**
6	Build mobile application to demonstrate Dynamic Fragments	**CO1, CO2, CO3, CO4, CO5**
7	Build mobile application serverless database SQLite Database, Firebase (cloud-hosted database)	**CO1, CO2, CO3, CO4, CO5**
8	Build mobile application based on the **Google Maps**	**CO1, CO2, CO3, CO4, CO5**

Learning Resources

Reference Books	1. Professional Android, Reto Meier, Ian Lake, 4th Edition, 2018, Wrox 2. Head First Android Development: A Brain-Friendly Guide, Dawn Griffiths, David Griffiths, 2015, O′Reilly

***Note: The above experiments are listed in generic format. Course Coordinators are advised to implement the above generic experiments using emerging technologies like: Flutter / Android Studio / .net core 5 …**

UNIVERSAL HUMAN VALUES

Course Code	20MC1602	**Year**	III	**Semester**	II
Course Category	MC	**Branch**	CSE	**Course Type**	Theory
Credits	0	**L-T-P**	2-0-0	**Prerequisites**	--
Continuous Internal Evaluation	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to:		
CO1	Understand the importance of universal human values and value education	**L2**
CO2	Understand the Harmony in human being, Family and society	**L2**
CO3	Apply a holistic perception of harmony at all levels of Existence	**L3**
CO4	Apply human values and professional ethics to the self, family, society, and day-to-day activities of real life.	**L3**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√							√				√		
CO2	√							√	√	√		√		
CO3								√		√		√	√	
CO4								√		√		√	√	

Syllabus		
Unit No.	**Contents**	**Mapped PO**
I	**Introduction - Need, Basic Guidelines, Content and Process for Value Education** Purpose and motivation for the course, recapitulation from Universal Human Values-I, Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfil the above human aspirations: understanding and living in harmony at various levels.	CO1
II	**Understanding Harmony in the Human Being - Harmony in Myself!** Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - happiness and physical facility, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer),Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health.	CO2
III	**Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship** Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co- existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.	CO2
IV	**Understanding Harmony in the Nature and Existence - Whole existence as Coexistence** Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all- pervasive space, Holistic perception of harmony at all levels of existence.	CO3

V	**Implications of the above Holistic Understanding of Harmony on Professional Ethics** Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations.	CO4

Learning Resources

Text Books

1. R R Gaur, R Sangal, G P Bagaria - Human Values and Professional Ethics by, Excel Books, New Delhi, 2010.
2. A Nagaraj, Jeevan Vidya Prakashan, Amarkantak - Jeevan Vidya: Ek Parichaya, 1999.

Reference Books

1. A.N. Tripathi, Human Values, New Age Intl. Publishers, New Delhi, 2004.
2. Mohandas Karamchand Gandhi - The Story of My Experiments with Truth

e- Resources & other digital material

1. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

TCP/IP

Course Code	20CS6621	**Year**	III	**Semester**	II
Course Category	Honors	**Branch**	CSE	**Course Type**	Theory
Credits	4	**L-T-P**	4-0-0	**Prerequisites**	Computer Networks
Continuous Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the fundamental concepts of TCP/IP architecture and protocols, with emphasis on the network layer and transport layer of the suite.	**L2**
CO2	Apply the concepts of flow control, error control and congestion control in the protocols of network layer and transport layer of the suite	**L3**
CO3	Analyze the network architecture and assign suitable network addresses.	**L4**
CO4	Analyze various services and features of Transport Layer Protocols.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√													
CO2	√												√	
CO3	√												√	
CO4		√							√	√			√	√

Syllabus		Mapped CO
Unit No.	**Contents**	
I	TCP/IP Protocol suite and Addressing, Delivery and forwarding of IP packets. IPV4 Addresses- Introduction, Classful and Classless Addressing, Special address, Network Address Translation (NAT). Internet Protocol Version4(IPv4) – Datagrams, Fragmentation, Options, Checksum, Security, IP Package.	**CO1, CO3**
II	IPv6 Addressing – Introduction, Address Space Allocation, Global Unicast Addresses, Auto configuration and Renumbering. IPv6 Protocol - Introduction, Packet Format, Transition from IPv4 to IPv6. *ICMPv6* - Introduction, Error Messages, Informational Messages, Neighbor Discovery Messages, Group Membership Messages.	**CO1, CO2, CO3**
III	Introduction to the Transport Layer – Transport Layer Services, Features, Segment, TCP Connection, Windows in TCP.	**CO1, CO2, CO4**
IV	Transmission Control Protocol – II: Flow Control, Error Control, Congestion Control, TCP Timers, Options and TCP Package.	**CO1, CO2, CO4**
V	Stream Control Transmission Protocol: Services, Features, Packet format, Association, STD, flow control, error control, congestion control, Internet Security: Network Layer security, Transport Layer Security	**CO1, CO2, CO4**

Learning Resources
Text Books
1. TCP/IP Protocol Suite , Behrouz A. Forouzan, 4th Edition, Tata McGraw-Hill Edition, 2017.
References
1. Internetworking with TCP/IP: Principles, Protocols and Architecture, 6th Edition, Douglas E Comer. Pearson, 2013. 2. TCP/IP Illustrated, Volume 1: The Protocols (computing Series), Kevin Fall and W. Stevens, Second Edition, Addison-Wesley,2011 3. TCP/IP Illustrated: The Implementation, Vol. 2, W. Richard Stevens and Gary R. Wright, First Edition, 2011
e-Resources & other digital material
1. https://www.geeksforgeeks.org/engineering-mathematics-tutorials/ 2. https://www.tutorialspoint.com/discrete_mathematics/index.htm 3. http://www.alas.matf.bg.ac.rs/~mi10164/Materijali/DS.pdf 4. https://nptel.ac.in/courses/111107058/

DATA VISUALIZATION

Course Code	20CS6621	**Year**	III	**Semester**	II
Course Category	**Honors**	**Branch**	CSE	**Course Type**	Integrated
Credits	4	**L-T-P**	3-0-2	**Prerequisites**	-
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand fundamental concepts of Data visualization	**L2**
CO2	Apply different techniques and views for effective visualization of data	**L3**
CO3	Analyze the given data and use appropriate technique for better visualization	**L4**
CO4	Apply different visualization techniques for effective understanding of data	**L3**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√													
CO2	√													√
CO3		√							√	√				√
CO4	√													√

Syllabus		Mapped CO
Unit No.	**Contents**	
I	**Foundations for an Applied Science of data visualization:** Visualization Stages, Gibson's Affordance theory, A Model of Perceptual Processing, Costs and Benefits of Visualization. Types of Data: entities, relationships, attributes of entities or relationships, data dimensions, types of numbers, uncertainty, and operations considered as data.	**CO1**
II	**The Visualization Pipeline:** Conceptual Perspective, Implementation Perspective, Algorithm Classification **Scalar Visualization:** Color Mapping, Designing Effective Color maps, Contouring, Height Plots	**CO1,CO2,CO3**
III	**Vector Visualization:** Vector Glyphs, Vector Color Coding, Displacement Plots, Texture-Based Vector Visualization Domain- Modeling Techniques: Cutting, Selection, Grid Construction from Scattered Points	**CO1,CO2,CO3**
IV	**Image Visualization:** Image Data Representation, Image Processing and Visualization, Shape representation and analysis	**CO1,CO2,CO3**
V	**Information Visualization:** What Is Infovis, Table Visualization, Visualization of Relations, Multivariate Data Visualization, Text Visualization	**CO1,CO2,CO3**

Learning Resources

Text Books

1. Information Visualization Perception for Design, Colin Ware , 3rd edition, Morgan Kaufman 2012.
2. Data Visualization: Principles and Practice, Alexandru C. Telea, A. K. Peters Ltd, 2008
3. Core Python Programming , R. Nageswara Rao, Second Edition, Dreamtech Press

References

1. Data Points: Visualization that means something, Nathan Yau,Wiley, 2013.
2. The visual display of quantitative information, Edward R. Tufte, Second Edition, 2001, Graphics Press
3. Interactive Data Visualization for the Web, Scott Murray, 2013 , O'Reilly.

e-Resources & other digital material

1. https://help.tableau.com/current/pro/desktop/en-us/default.html
2. https://www.ibm.com/cloud/learn/data-visualization
3. https://www.oreilly.com/library/view/interactive-data-visualization/9781491921296/
4. http://web.cse.ohiostate.edu/~shen.94/5544/
5. https://www.coursera.org/learn/datavisualization

Experiments:

Syllabus		
Exp. No.	**Contents**	**Mapped CO**
I	Generate a simple graph by using python matplotlib	**CO1,CO2,CO3, CO4,CO5**
II	Implement different types of plots available in python matplotlib	**CO1,CO2,CO3, CO4,CO5**
III	Develop multiple plots using subplot( ) function in matplotlib	**CO1,CO2,CO3, CO4,CO5**
IV	Demonstrate how to connect to various data sources in Tableau	**CO1,CO2,CO3, CO4,CO5**
V	Develop customized views by using Ask Data component in Tableau	**CO1,CO2,CO3, CO4,CO5**
VI	Build data views from scratch using Tableau	**CO1,CO2,CO3, CO4,CO5**

Learning Resources	
Text Books	
1	Data Visualization in Python, Daniel Nelson , StackAbuse
2	Data Visualization in Python with Pandas and Matplotlib, David Landup , StackAbuse
3	Information Dashboard Design by Stephen Few ,Second Edition, Analytics Press
References	
1	The Data Loom by Stephen Few, Analytics Press
e-Resources & other digital material	
1	https://matplotlib.org/2.0.2/
2	

DISTRIBUTED DATABASES

Course Code	20CS6621	**Year**	III	**Semester**	II
Course Category	Honors	**Branch**	CSE	**Course Type**	Theory
Credits	4	**L-T-P**	4-0-0	**Prerequisites**	Database Management Systems
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the principles of Distributed Databases, Architectures and Design	**L2**
CO2	Apply the concepts of query processing and optimization for Distributed Databases	**L3**
CO3	Apply reliability concepts to analyse various reliability features of a distributed database.	**L3**
CO4	Analyze various mechanisms/algorithms of Transactions for a given context	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√													
CO2	√								√	√			√	
CO3	√								√	√			√	
CO4		√							√	√			√	√

Syllabus		
UNIT-1	**Introduction;** Distributed Data Processing, Distributed Database System, Promises of DDBSs, Design Issues **Distributed DBMS Architecture**: Architectural Models for Distributed DBMS. **Distributed Database Design:** Top-Down Design Process, Distribution Design issues, Fragmentation, Allocation	**CO1**
UNIT-2	**Query processing and decomposition:** Query processing objectives, characterization of query processors, layers of query processing, query decomposition, localization of distributed data.	**CO1,CO2**
UNIT-3	**Distributed query Optimization:** Query optimization, centralized query optimization, Join Ordering in Distributed Queries ,distributed query optimization algorithms	**CO1,CO2**
UNIT-4	**Transaction Management:** Definition, properties of transaction, types of transactions, distributed concurrency control: serializability, concurrency control mechanisms & algorithms, time - stamped & optimistic concurrency control Algorithms.	**CO1, CO4**
UNIT-5	**Distributed DBMS Reliability:** Reliability concepts and measures, fault-tolerance in distributed systems, failures in Distributed DBMS, local & distributed reliability protocols.	**CO1,CO3**

Learning Resources	
Text books:	
1	Principles of Distributed Database Systems, M. Tamer OZSU and Patuck Valduriez, 2011, Pearson Edition.
References:	
1	Distributed Databases, Stefano Ceri and Giuseppe Pelagatti, McGraw Hill.
2	Database Systems: The Complete Book ,Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom, Second Edition, Pearson International Edition
e-Resources and other Digital Material:	
1	https://www.my-mooc.com/en/mooc/distributed-database-systems/

WEB TECHNOLOGIES

Course Code	20CS5621	**Year**	III	**Semester**	II
Course Category	Minor	**Branch**		**Course Type**	Integrated
Credits	4	**L-T-P**	3-0-2	**Prerequisites**	Programming with Java
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the fundamental concepts of web application development.	**L2**
CO2	Apply basic Front-End Technologies to create static and dynamic web pages.	**L3**
CO3	Apply JDBC Driver to design application and manipulate databases	**L3**
CO4	Apply the concepts of server side technologies for creating dynamic web applications.	**L3**
CO5	Analyze static and dynamic web pages using Front-End Technologies and server side technologies for posting and retrieving data	**L4**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**HTML:** Understanding 3-tier Web Architecture, Overview of HTTP, Introducing HTML document structure, Creating Headings on a web page, Working with links, Creating a Paragraph, Working with images, Working with tables, working with frames, Introduction to Forms and HTML controls. **Cascading Style Sheets:** Inline, Internal and External Style Sheets, Style class, Multiple styles.	**CO1,CO2, CO5**
II	**JavaScript:** Introducing DHTML, Introducing JavaScript, Client Side benefits of using JavaScript, Embedding JavaScript in an HTML page, Using Variables, Using Operators, Working with Control Flow statements, Working with functions, Handling Events, Using Arrays, Creating objects in JavaScript. **XML**: Introduction to XML: Syntax of XML, document structure, and document type definition.	**CO1, CO2, CO5**

III	**JDBC:** Java Database Connectivity: JDBC Connectivity, Types of JDBC drivers, Steps to write a JDBC application, JDBC Statements, Manipulations on the database.	**CO1, CO3, CO5**
IV	**Servlets :** Introduction to Servlets: Lifecycle of a servlet, the servlet api, the javax.servlet package, the javax.servlet.http package, handling http request & responses, Servlets with database connectivity. Introduction to Model View Controller (MVC): Architecture.	**CO1, CO4, CO5**
V	**JSP:** Introduction to JSP: The problem with servlet, the anatomy of a JSP page, JSP processing, JSP applications, JSP components, comments, expressions, scriptlets, JSP database connectivity	**CO1, CO4, CO5**

Learning Resources

Text Book

1. Web Technologies, Black Book, Kogent Learning Solutions Inc, Dreamtech Press.
2. Java Servlet Programming, Jason Hunter, William Crawford, Second edition, 2003, O'Reilly, 2003
3. Programming the World Wide Web, Robert W.Sebesta, Fourth edition, 2007, Pearson.

References

1. Internet and World Wide Web - How to program, Dietel and Nieto, 2006, PHI/Pearson Education.
2. JAVA The Complete References, Herbert Schildt, Eighth edition, 2014, McGraw Hill.
3. Web Technologies, UttamK.Roy, 2004, Oxford Higher Education publication.
4. Web Warrior Guide to Web Programming, Bai Ekedaw, 2012, Thompson Publications.

e-Resources and other Digital Material

1. www.w3schools.com
2. Prof. I. Sengupta. (14th, May, 2017), Department of Computer Science & Engineering, I.I.T.,Kharagpur, “Internet Technologies", NPTEL videos.

Experiments:

Syllabus		
Expt. No.	**Contents**	**Mapped CO**
1	Design static web sites with html tags by taking different examples.	**CO1, CO2, CO3, CO4, CO5**
2	Design web pages using different types of CSS.	**CO1, CO2, CO3, CO4, CO5**
3	Apply Client side validations using JavaScript	**CO1, CO2, CO3, CO4, CO5**
4	Create an XML file for student/employee/book data and validate against DTD	**CO1, CO2, CO3, CO4, CO5**
5	Develop different JDBC applications to interact with database.	**CO1, CO2, CO3, CO4, CO5**
6	Create different web applications using servlets	**CO1, CO2, CO3, CO4, CO5**
7	Develop different web applications using JSP	**CO1, CO2, CO3, CO4, CO5**
8	Build web applications (case studies) based on the choice of student/faculty	**CO1, CO2, CO3, CO4, CO5**

Learning Resources
Text Books
1. Web Technologies, Black Book, Kogent Learning Solutions Inc, Dreamtech Press, 2009 2. JavaServer Pages,Hans Bergsten, Thirrd Edition, 2017, O'Reilly Media
Reference Books:
1. The Complete reference to J2EE, Jim Keogh, 2017, Tata McGrawHill. 2. Advanced Java 2 Platform How to Program‖, H. M. Deitel, P.J. Deitel, S.E. Santry, Third Edition, 2016, Prentice Hall Publications. 3. Java Servlet Programming, Jason Hunter, William Crawford, Second edition, 2003 O'Reilly.
e- Resources & other digital material
1. www.w3schools.com 2. Prof. I. Sengupta. (14th , May, 2017), Department of Computer Science & Engineering, I.I.T.,Kharagpur, "Internet Technologies", NPTEL videos.

Deep Learning

Course Code	20CS4701A	**Year**	IV	**Semester**	I
Course Category	PEC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Machine Learning
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

COURSE OUTCOMES		
Upon successful completion of the course, the student will be able to		
CO1	Understand the fundamental concepts of Deep learning.	**L2**
CO2	Apply concepts of deep networks to analyze various architectures.	**L3**
CO3	Apply deep learning models to build applications in various domains.	**L3**
CO4	Analyze the given problem and apply suitable deep learning algorithm.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√													
CO2										√			√	
CO3	√									√				
CO4		√							√	√		√		

SYLLABUS		
UNIT NO.	**CONTENTS**	**MAPPED CO**
I	**Fundamentals of Deep Networks** – Defining Deep Learning, What Is Deep Learning? Common Architectural Principles of Deep Networks: Parameters, Layers, Activation Functions, Loss Functions, Hyper parameters.	**CO1**
II	**Building Blocks of Deep Networks** – Restricted Boltzmann Machine, Autoencoders, Variational Autoencoders. **Major Architectures of Deep Networks:** Unsupervised pretrained networks, Deep Belief Networks, Generative Adversarial Networks.	**CO1, CO2, CO4**
III	**Convolutional Neural Networks (CNNs)** – The Convolution Operation, Motivation, Pooling, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features, The Neuro-scientific Basis for Convolutional Networks, Applications.	**CO1, CO3, CO4**
IV	**Sequence Modeling – Recurrent and Recursive Nets** – Unfolding Computational Graphs, Recurrent Neural Networks, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Long Short-Term Memory and Other Gated RNNs, Applications.	**CO1, CO3, CO4**
V	**Deep Learning applications** – Computer Vision, Speech Recognition, Natural Language Processing, Other Applications.	**CO1, CO3, CO4**

Learning Resources
Text books
1. Josh Patterson and Adam Gibson, ―Deep learning: A practitioner's approach‖, O'Reilly Media, First Edition, 2017. 2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, ―Deep Learning‖, MIT Press, 2016. 3. Deep learning,Amit Kumar Das,Saptarsi Goswami, Pabitra Mitra, Amlan Chakrabarti, First Edition,2021, Pearson.
References
1. Fundamentals of Deep Learning, Designing next-generation machine intelligence algorithms, Nikhil Buduma, O‘Reilly, Shroff Publishers, 2019. 2. Deep learning Cook Book, Practical recipes to get started Quickly, Douwe Osinga, O‘Reilly, Shroff Publishers, 2019. 3. Deep learning Illustrated A Visual Interactive Guide to Artificial Intelligence,Jon Krohn,Grant Beyleveld,Aglae Bassens,First Edition,2020, Pearson.
e-Resources and other Digital Material
1. https://www.deeplearningbook.org/S 2. https://onlinecourses.nptel.ac.in/noc20_cs62/preview 3. https://www.udemy.com/share/101X6W/ (or) https://www.udemy.com/course/deep-learning-advanced-nlp/ 4. https://www.youtube.com/watch?v=5tvmMX8r_OM&list=PLtBw6njQRU-rwp5__7C0oIVt26ZgjG9NI

Software Testing Methodologies

Course Code	20CS4701B	**Year**	IV	**Semester**	I
Course Category	PEC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Software Engineering
Continuous Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the importance and significance of Software Testing.	**L2**
CO2	Apply the functional testing techniques to design test cases	**L3**
CO3	Apply Structural Testing techniques and creating test cases from use cases and requirements	**L3**
CO4	Apply the selection, minimization, Prioritization of test cases for regression Testing.	**L3**
CO5	Analyse test strategies and data generation techniques	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√													
CO2	√													
CO3	√													
CO4														√
CO5		√							√	√				

Syllabus		Mapped CO
Contents		
UNIT-1	**Introduction:** Testing process, some terminologies. **Functional testing:** Boundary value analysis, Equivalence class testing, decision table based testing, cause effect graphing technique.	**CO1,CO2**
UNIT-2	**Structural Testing:** control flow testing, data flow testing, slice based testing, mutation testing.	**CO1,CO3,CO5**
UNIT-3	**Creating test cases from requirements and use cases:** Use case diagram and use cases, generation of test cases from use cases, guidelines for generating validity checks, strategies for generating validity checks, strategies for data validity.	**CO1,CO3, CO5**
UNIT-4	**Selection, Minimization and prioritization of test cases for regression testing:** what is regression testing? , Regression test cases selection, reducing the number of test cases, risk analysis, code coverage prioritization technique.	**CO1,CO4, CO5**
UNIT-5	**Automated Test data generation:** what is Automated Test data generation?, Approaches to Test data generation, Test data generation using genetic algorithm, Test data generation tools.	**CO1,CO5**

Learning Resources
Text Books
1. Software Testing, Yogesh Singh, , First Edition,2013, Cambridge .ISBN978-1-107-01296-1
Reference Books
1. Software Testing: Principles and Practices, Naresh Chauhan, Second edition,2016, Oxford. 2. Software Testing Techniques – SPD(Oreille) 3. Software Testing in the Real World – Edward Kit, Pearson. 4. Effective methods of Software Testing, Perry, John Wiley. 5. Art of Software Testing – Meyers, John Wiley.
e- Resources & other digital material
1. https://nptel.ac.in/courses/106105150

Cloud Computing

Course Code	20CS4701C	**Year**	IV	**Semester**	I
Course Category	PEC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Computer Networks, Operating Systems
Continuous Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon Successful completion of course, the student will be able to		
CO1	Understand the basic concepts of virtualization and Cloud Computing.	**L2**
CO2	Apply cloud computing framework to build and deploy customized applications	**L3**
CO3	Analyze the given application and choose suitable platform for deploying cloud.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√													
CO2														√
CO3		√							√	√				

Syllabus		
Unit No	**Contents**	**Mapped CO**
I	**Introduction to Cloud**: Cloud Computing at a Glance, The Vision of Cloud Computing, Defining a Cloud, A Closer Look, Cloud Computing Reference Model, Characteristics and Benefits. **Virtualization:** Introduction, Characteristics of Virtualized Environment, Taxonomy of Virtualization Techniques, Virtualization and Cloud computing, Pros and Cons of Virtualization, Technology Examples- VMware and Microsoft Hyper-V.	**CO1**
II	**Cloud Computing Architecture :** Introduction, Cloud Reference Model, Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds.	**CO1,CO2,CO3**
III	**Aneka:** Cloud Application Platform Framework Overview, Anatomy of the Aneka Container, From the Ground Up: Platform Abstraction Layer, Fabric Services, Foundation Services, Application Services, Building Aneka Clouds, Infrastructure Organization, Logical Organization, Private Cloud Deployment Mode, Public Cloud Deployment Mode, Hybrid Cloud Deployment Mode.	**CO1,CO2,CO3**
IV	**Cloud Applications:** Scientific Applications – Health care, Geoscience and Biology. Business and Consumer Applications- CRM and ERP, Social Networking, Media Applications and Multiplayer Online Gaming.	**CO1,CO3**
V	**Cloud Platforms in Industry:** Amazon Web Services- Compute Services, Storage Services, Communication Services and Additional Services. Google App Engine-Architecture and Core Concepts, Application Life-Cycle, cost model. Microsoft Azure- Azure Core Concepts, SQL Azure.	**CO1,CO3**

Learning Resources
Text Books
1. Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi, 2013, TMH.
References
1. Cloud Computing Principles and Paradigms, Rajkumar Buyya , James Broberg, Andrzej Goscinski, Wiley Publishing. 2. Cloud Application Architectures, George Reese , First Edition, O‟Reilly, Media 2009. 3. Cloud Computing – web based Applications that change the way you work and collaborate Online, Micheal Miller,.Pearson Education.
e-Resources and other Digital Material
1. http://www.slideshare.net/himanshuawasthi2109/cloud-computing-ppt-16240131 2. https://nptel.ac.in/courses/106105167 3. https://www.youtube.com/watch?v=r8Lu_BjxlZc 4. http://video.mit.edu/watch/mitef-nyc-cloud-computing-8347/

Adhoc and Sensor Networks

Course Code	20CS4701D	**Year**	IV	**Semester**	I
Course Category	PEC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Computer Networks
Continuous Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the Basic Concepts of Adhoc and Sensor Networks	**L2**
CO2	Apply appropriate MAC & Routing Protocols for a given scenario	**L3**
CO3	Apply suitable Transport Protocols for a given scenario.	**L3**
CO4	Apply the concept of data dissemination, localization for a given network to achieve best QoS in WSN	**L3**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√													
CO2	√								√	√				
CO3	√								√	√				
CO4													√	

Syllabus		Mapped CO
Unit No.	**Contents**	
I	**Adhoc Wireless Networks** – Introduction, Issues In Ad Hoc Wireless Networks, Adhoc Wireless Internet Mac Protocols For Ad Hoc Wireless Networks – Design Goals Of A Mac Protocol For Ad Hoc Wireless Networks, Classifications Of MAC protocols, Contention-Based Protocols, Contention-Based Protocols With Reservation Mechanisms, Contention-Based MAC protocols With Scheduling Mechanisms	**CO1, CO2**
II	**Routing Protocols For Ad Hoc Wireless Networks -** Issues In Designing A Routing Protocol For Ad Hoc Wireless Networks, Classifications Of Routing Protocols, Table-Driven Routing Protocols, On-Demand Routing Protocols, Hybrid Routing Protocols.	**CO1, CO2**
III	**Transport Layer And Security Protocols For Ad Hoc Wireless Networks** – Issues In Designing A Transport Layer Protocol For Ad Hoc Wireless Networks, Design Goals Of A Transport Layer Protocol For Ad Hoc Wireless Networks, Classification Of Transport Layer Solutions, TCP Over Ad Hoc Wireless Networks, Security In Ad Hoc Wireless Networks.	**CO1, CO3**
IV	**Wireless Sensor Networks :** Introduction, WSN architecture, Data dissemination, data gathering, MAC Protocols for WSN, localization,	**CO1, CO4**
V	**Quality Of Service :** Quality Of A Sensor Network, Other Issues – Energy Efficient Design-Synchronization-Transport Layer issues, security, Real Time Communication	**CO1, CO4**

Learning Resources
Text Books
1. Ad Hoc Wireless Networks – Architectures and Protocols, C. Siva Ram Murthy and B.S. Manoj, First Edition, Prentice Hall, 2014.
References
1. Wireless Sensor Networks – An Information Processing Approach, Feng Zhao and Leonidas Guibas, First Edition, Elsevier Publications,2005. 2. Protocols and Architectures for Wireless Sensor Networks, Holger Karl and Andreas Willig, John Wiley and Sons, 2011.
e-Resources & other digital material
1. https://www.geeksforgeeks.org/engineering-mathematics-tutorials/ 2. https://www.tutorialspoint.com/discrete_mathematics/index.htm 3. http://www.alas.matf.bg.ac.rs/~mi10164/Materijali/DS.pdf 4. https://nptel.ac.in/courses/111107058/

Advanced Data Mining

Course Code	20CS4702A	**Year**	IV	**Semester**	I
Course Category	PEC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Machine Learning
Continuous Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the basic techniques utilized in data mining.	**L2**
CO2	Apply suitable technique to extract patterns/information from various application areas of mining.	**L3**
CO3	Develop the knowledge for application of data mining and social impacts of data mining.	**L3**
CO4	Analyze the given scenario and use the appropriate technique based on application areas for mining.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**		**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√													
CO2	√					√	√							
CO3						√	√							√
CO4		√				√	√		√	√				

Syllabus		Mapped CO
Unit No.	Contents	
I	**Mining Frequent Patterns:** Basic Concepts, Efficient and scalable frequent item set mining methods: Apriori algorithm, Generating Association Rules from Frequent Item sets, Improving the efficiency of Apriori , A pattern – Growth Approach for Mining Frequent Item sets. **Advanced Pattern Mining:** Mining Multilevel Associations, Mining Multidimensional Associations, Mining Quantitative Association Rules, and Applications of Pattern Mining.	**CO1,CO2,CO4**
II	**Classification: Advanced Methods** Bayesian Belief Networks, Classification Using Frequent Patterns, Other Classification methods: Genetic Algorithms, Rough set Approach, Fuzzy set Approaches, Additional topics Regarding Classification: Multiclass Classification. Semi supervised classification, Active Learning, Transfer Learning	**CO1,CO2,CO4**
III	**Cluster Analysis: Additional Issues and Algorithms** Prototype Clustering, Density Based Clustering, Graph-Based Clustering, Scalable Clustering Algorithm , Which Clustering Algorithm	**CO1,CO2,CO4**
IV	**Social Network Analysis:** Social Network Analysis - Centrality, Prestige. Co-Citation and Bibliographic Coupling - Co-Citation, Bibliographic Coupling. PageRank - PageRank Algorithm. HITS - HITS Algorithm, Finding Other Eigenvectors, Relationships with Co-Citation and Coupling, Strengths and Weaknesses of HITS.	**CO1,CO3,CO4**
V	**Data Mining Trends and Research Frontiers** Mining Complex Data Types: Sequence Mining, Spatial Mining, Web mining, Stream Mining Data Mining Applications, Data Mining and Society: Ubiquitous and Invisible Data Mining, Privacy , security and Social impacts of data Mining	**CO1,CO3,CO4**

Learning Resources
Text Books
1. **Data** Mining: Concepts and Techniques, Jiawei Han and Micheline Kamber, Morgan Kaufmann Publishers, Third edition ,2013 2. Introduction to Data Mining, Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar, Second edition, Pearson, 2019. 3. Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data, Bing Liu, Springer Publications.
References
1. Principles of Data Mining , Hand, D., Mannila, H. and Smyth, P., MIT Press: Massachusets, Third edition, 2013, Pearson. 2. Data Warehousing, Data Mining & OLAP, Alex Berson and Stephen J. Smith, 2008, Tata McGraw Hill Edition.
e- Resources & other digital material
1. https://onlinecourses.nptel.ac.in/noc21_cs06

Software Project Management

Course Code	20CS4702B	**Year**	IV	**Semester**	I
Course Category	PEC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Software Engineering
Continuous Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the fundamentals of Project Management principles while developing software.	**L2**
CO2	Apply a suitable software process model to develop a project.	**L3**
CO3	Apply the effort Estimation techniques to prepare accurate project estimatio	**L3**
CO4	Analyze and estimate cost, risk and outline the project plan	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√											√		
CO2									√			√		√
CO3	√		√						√			√		
CO4		√				√						√		

Syllabus		Mapped CO
Unit No.	**Contents**	
I	**Introduction to Software Project Management** Introduction, Why is Software Project Management Important?, Software Projects versus Other Types of Project, Activities Covered by Software Project Management, Traditional versus Modern Project Management Practices	**CO1**
II	**Project Evaluation and Programme Management** Introduction, A Business Case, Project Portfolio Management, Evaluation of Individual Projects, Cost–benefit Evaluation Techniques, Strategic Programme Management, Creating a Programme, Benefits Management	**CO1, CO2,CO4**
III	**Selection of an Appropriate Project Approach** Introduction, Build or Buy? Choosing Methodologies and Technologies, Software Processes and Process Models, The Waterfall Model, The Spiral Model, Software Prototyping.	**CO1, CO2,CO4**
IV	**Software Effort Estimation** Introduction, Problems with Over and Under-Estimates, The Basis for Software Estimating, COSMIC Full Function Points.	**CO1, CO3,CO4**
V	**Risk Management** Introduction, Risk, Categories of Risk, Risk Identification, Risk Assessment, Risk Planning, Risk Management.	**CO1, CO2,CO4**

Learning Resources
Text Books
1. Software Project Management, Bob Hughes, Mike Cotterell and Rajib Mall, Fifth Edition, Tata McGraw Hill, New Delhi, 2012.
References
1. —Software Project Management in Practice‖, Pankaj Jalote, 2002, Pearson, Education Asia. 2. —Information Technology Project Management‖, Jack T Marchewka, Third Edition (International Student Version) , Wiley India 3. —Project Management- Core Textbook‖, Samuel J mantel et'al., First India Edition, Wiley India.
e-Resources & other digital material
1. https://nptel.ac.in/courses/106105218 2. https://www.digimat.in/nptel/courses/video/106105218/L01.html

Cyber Security

Course Code	20CS4702C	**Year**	IV	**Semester**	I
Course Category	PEC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Computer Networks
Continuous Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the basic concepts of cybercrime and offences	**L2**
CO2	Apply various methods and tools to identify various Cyber Crimes	**L3**
CO3	Apply different security measures on mobile devices.	**L3**
CO4	Analyze the cyber security requirements/measures for an IT Infrastructure	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	PO3	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√													
CO2						√	√		√	√				√
CO3						√	√	√						√
CO4						√	√	√						√

Syllabus		Mapped CO
Unit No.	**Contents**	
I	**Introduction to Cybercrime:** Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes.	**CO1**
II	**Cyber Offenses:** How Criminals Plan Them: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, and Cloud Computing. OWASP Web Goat.	**CO1,CO2**
III	**Cybercrime: Mobile and Wireless Devices:** Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Organizational Measures for Handling Mobile, Organizational Security Policies an Measures in Mobile Computing Era, Laptops.	**CO1,CO2,CO3**
IV	**Tools and Methods Used in Cybercrime:** Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.	**CO1,CO2,CO3**
V	**Cyber Security:** Organizational Implications Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.	**CO1**

Learning Resources
Text Books
1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Prespectives, Nina Godbole and Sunil Belapure, First edition, 2011, Wiley INDIA.
References
1. James Graham, Richard Howard and Ryan Otson, Cyber Security Essentials, First edition, 2011, CRC Press. 2. Chwan-Hwa(John) Wu,J.David Irwin, Introduction to Cyber Security, First edition, 2013, CRC Press T&F Group.
e-Resources & other digital material
1. https://www.coursera.org/learn/intro-cyber-attacks?specialization=intro-cyber-security 2. https://www.coursera.org/learn/introduction-cybersecurity-cyber-attacks?specialization=it-fundamentals-cybersecurity 3. https://www.coursera.org/learn/cybersecurity-for-everyone 4. https://github.com/WebGoat/WebGoat 5. https://owasp.org/www-project-webgoat/#:~:text=WebGoat%20is%20a%20deliberately%20insecure,and%20popular%20open%20source%20components.

Reinforcement Learning

Course Code:	20CS4702D	**Year:**	IV	**Semester:**	I
Course Category:	PEC	**Branch:**	CSE	**Course Type:**	Theory
Credits:	3	**L-T-P:**	3-0-0	**Pre requisites:**	Probability and Statistics
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to:		
CO1	Understand the concepts of Reinforcement Learning to solve real world problems.	**L2**
CO2	Apply Markov Decision Process, Monte Carlo, Temporal Difference methods for policy evaluation and prediction	**L3**
CO3	Analyze the Tabular Methods and On-policy Prediction with Approximation.	**L4**
CO4	Analyze a given problem and use the suitable Reinforcement Techniques.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO 1	√													
CO 2	√													√
CO 3		√				√								
CO 4		√							√	√		√		

Syllabus		
Course Content		
UNIT-1	**Reinforcement Learning Primitives:** Introduction and Basics of RL, Defining RL Framework, Probability Basics: Probability Axioms, Random Variables, Probability Mass Function, Probability Density Function, Introduction to Agents, Intelligent Agents – Problem Solving – Searching, Logical Agents.	**CO1,CO4**
UNIT-2	**Finite Markov Decision Process:** Basics, The Agent-Environment Interface, Goals and Rewards, Returns and Episodes, Unified Notation for Episodic and Continuing Tasks, Policies and Value Functions, Optimal Policies and optimal Value Functions.	**CO1, CO2,CO4**
UNIT-3	**Dynamic Programming**: Definition, Policy Evaluation (Prediction), Policy Improvement, Policy Iteration, Value Iteration, Asynchronous dynamic programming, Generalized Policy Iteration, Efficiency of dynamic programming. **Monte Carlo Methods:** Definition, Monte Carlo Prediction, Monte Carlo Estimation of Action values, Monte Carlo Control, Monte Carlo Control without Exploring Starts.	**CO1, CO2,CO4**
UNIT-4	**MONTE CARLO METHODS FOR MODEL FREE PREDICTION AND CONTROL AND TD METHODS:** **Temporal-Difference Learning:** TD Prediction, Advantages of TD Prediction Methods, Optimality of TD(0), **Sarsa:** On-policy TD control, Q-learning Off-policy TD control.	**CO1, CO2, CO4**
UNIT-5	**ELIGIBILITY TRACES AND REINFORCE** **Planning and Learning with Tabular Methods:** Models and Planning, **Dyna:** Integrated Planning, acting and learning, Prioritized Sweeping, Real-time dynamic programming, Planning at decision time, Heuristic search, Rollout algorithms, Monte carlo tree search.	**CO1, CO3, CO4**
Learning Resources		
Text Books	**1.** Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An Introduction", Second Edition, MIT Press, 2019. **2.** Russell, Stuart J., and Peter Norvig. "Artificial intelligence: a modern approach.", Pearson	
Reference Books	1. Alberto Leon-Garcia, "Probability, Statistics, and Random Processes for Electrical Engineering", 3rd Edition,	
e-Resources & other	1. https://www.udemy.com/course/artificial-intelligence-az/ 2. https://nptel.ac.in/courses/106106143 3. https://www.coursera.org/specializations/reinforcement-learning	

Big Data Analytics

Course Code	20CS4703A	**Year**	IV	**Semester**	I
Course Category	PEC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Machine Learning
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the fundamental concepts of big data	**L2**
CO2	Apply Hadoop Distributed File Systems for storing Big data	**L3**
CO3	Apply the concepts of Map reduce, Spark and Hive for processing the Big Data	**L3**
CO4	Apply various analytics mechanisms to design a recommender system.	**L3**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√													
CO2	√									√				
CO3	√									√				
CO4						√	√		√	√				√

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Meet Hadoop:** Data, Data Storage and Analysis, Querying All Your data, Beyond Batch, Comparison with Other Systems: Relational database Management Systems, Grid Computing, Volunteer Computing. **Map Reduce:** A Weather Dataset: Data Format, Analyzing the data with Unix Tools, Analyzing the Data with Hadoop: Map and Reduce, Java MapReduce, Scaling Out: Data Flow, Combiner Functions.	**CO1,CO3**
II	**The Hadoop Distributed File system:** The Design of HDFS, HDFS Concepts, The Command Line Interface, Hadoop Filesystems, The Java Interface, Data Flow, Parallel Copying with distcp.	**CO1,CO2**
III	**Hive:** Hive Shell, An Example, Running Hive: Configuring Hive, Hive Services, The Metastore, Comparison with Traditional Databases: Schema on Read Versus Schema on write, Updates, transactions, and Indexes. **HiveQL:** Data Types, Operators and Functions and Tables: managed Tables and External Tables, Partitions and Buckets, Storage Formats, Importing Data, Altering Tables and Dropping Tables.	**CO1,CO3**
IV	**Spark:** Installing Spark, An Example: Spark Applications, Jobs, Stages, and Tasks, A Scala Standalone Application, A Java Example, A Python Example, Resilient Distributed Datasets: Creation, Transformations and Actions, Persistence, Serialization, Shared Variables: Broadcast Variables, Accumulators, Anatomy of a Spark Job: Run:Job Submission, DAG Construction, Task Scheduling, Task Execution	**CO1,CO3**
V	**Use case Study:** Recommendation Systems: Introduction, A Model for Recommendation Systems, Collaborative Filtering System and Content Based Recommendations.	**CO1,CO4**

Learning Resources	
Text Books	
1	Hadoop: The Definitive Guide, Tom While ,Fourth Edition,O'Reilly.
2	Big Data Analytics, RadhaShankarmani, M Vijayalakshmi , Second Edition, 2017, Wiley.
References	
1	Hadoop Essentials: A Quantitative Approach, Henry H. Liu , First Edition, 2012, PerfMath Publishers
2	Big Data and Analytics, Seema Acharya, SubhashiniChellappan, First Edition, 2015, Wiley.
3	Big data analytics with R and Hadoop, VigneshPrajapati,First Edition, 2013, SPD.
4	Spark: The Definitive Guide :Big Data Processing Made simple, Bill Chambers and MateiZaharia , First Edition, 2018 , O'Reilly
e-Resources and other Digital Material	
1	https://nptel.ac.in/courses/106/104/106104189/
2	https://www.coursera.org/specializations/big-data
3	https://www.edx.org/course/big-data-fundamentals

Distributed Systems

Course Code:	20CS4703B	**Year:**	IV	**Semester:**	I
Course Category:	PEC	**Branch:**	CSE	**Course Type:**	Theory
Credits:	3	**L-T-P:**	3-0-0	**Prerequisites:**	Data Structures, Operating Systems , Computer Networks
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the fundamental concepts of distributed systems.	L2
CO2	Apply the principles of system models and characteristics of file systems to design distributed systems.	L3
CO3	Apply node level operating system facilities and networking protocols in distributed systems.	L3
CO4	Analyze the principles and techniques behind the design of distributed systems.	L4

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√													
CO2									√	√				√
CO3	√								√	√				
CO4		√							√	√				

Syllabus		
Unit No.	**CONTENTS**	**Mapped CO**
I	Characterization of Distribution Systems – Introduction, Examples of distributed systems, Trends in distributed systems, Challenges, Case study: The World Wide Web.	**CO1, CO2**
II	System Models – Introduction, Physical models, Architecture models, Fundamental models	**CO1, CO2, CO4**
III	Networking and Internetworking – Introduction, Types of networks, Network principles, Internet protocols. Inter-process communication – Introduction, Case Study: MPI. Remote Invocation – Introduction, Request reply protocols, Remote procedure calls, Remote method invocation.	**CO1, CO3, CO4**
IV	Operating System Support – Introduction, The operating system layer, process and threads, virtualization at the operating system level. Transaction and Concurrency Control – Introduction, Transaction, Nested Transaction, Locks, and Optimistic concurrency control.	**CO1, CO3, CO4**
V	Distributed File Systems – Introduction, Characteristics of file systems, File service architecture, Distributed file system requirements, File service architecture.	**CO1, CO2, CO4**

Learning Resources

Text Books

1. Distributed Systems: Concepts and Design, George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair, Fifth Edition, 2017, Pearson

References Text Book

1. Distributed Systems: Principles and Paradigms, Andrew S. Tannenbaum and Maarten Van Steen, 2016, Pearson
2. Advanced Concepts in Operating Systems, M. Singhal and N. G. Shivaratri, 2001, McGraw-Hill

e-Resources and other Digital Material

1. https://www.classcentral.com/tag/distributed-systems
2. https://youtu.be/cQP8WApzIQQ
3. https://onlinecourses.nptel.ac.in/noc21_cs87/preview
4. https://online.stanford.edu/courses/cs244b-distributed-systems

User Interface Design

Course Code	20CS4703C	**Year**	IV	**Semester**	I
Course Category	PEC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	-
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the concepts and principles of graphical user interface design	**L2**
CO2	Apply concepts of interaction devices to identify appropriate devices for an application	**L3**
CO3	Analyze given scenario and apply screen elements and windows to design a screen	**L4**
CO4	Analyze human physical and mental limitations for using computers to provide solutions.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√				√							√		
CO2	√								√			√		
CO3		√	√						√			√	√	
CO4		√				√	√					√		

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction to User Interface:** Defining the user interface and its importance, The importance of Good design, Benefits of Good design, History of Screen design, Characteristics of graphical and web user interfaces, Principles of user interface design	**CO1**
II	**Design Process:** Understanding how people interact with computers, Human characteristics in Design, Human Considerations , Human Interaction speeds	**CO1,CO4**
III	**Screen Designing:** Screen and Web Page Meaning and Purpose, organizing screen elements, ordering of screen data and content, screen navigation and flow, visually pleasing composition, Presenting information simply and meaningfully.	**CO1,CO 3**
IV	**Windows:** Characteristics, Components, Types, Selection of device based and screen based controls. **Components:** Icons and images, Multimedia, Color and its uses	**CO1, CO3**
V	**Interaction devices:** Keyboards and Keypads, pointing devices, speech and Auditory Interfaces	**CO1,CO2**

Learning Resources
Text Book
1. ―The Essential Guide to User Interface Design- An Introduction to GUI Design Principles and Techniques‖, Wilbert O Galitz, 3rd Edition, Wiley Dreama Tech 2. Designing the User Interface. Ben Shneidermann, 5th Edition, Pearson Education Asia
References
1 Human Computer Interaction. Alan Dix, Janet Finlay, Goryd, Abowd, Russell Beal,3rd Edition, 2004, PEA. 2. User Interface Design. Soren Lauesen, Pearson Education.
e-Resources and other Digital Material
1. http://iiscs.wssu.edu/drupal/node/4607 2. https://www.interaction-design.org/encyclopedia/human_computer_interaction_hci.html

Natural Language Processing

Course Code	20CS4703D	**Year**	IV	**Semester**	1
Course Category	PEC	**Branch**	CSE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Machine Learning
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the fundamental concepts of Natural language processing.	**L2**
CO2	Apply basic evaluating language models for the probability of the test set.	**L3**
CO3	Apply techniques for extracting limited forms of semantic content from texts.	**L3**
CO4	Analyze parsing algorithms through the use of context-free.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√													
CO2										√			√	
CO3	√									√				
CO4		√							√	√		√		

Syllabus		
Unit No	**Contents**	**Mapped CO**
I	**Regular Expressions, Text Normalization, Edit Distance-** Regular Expression, Words, Corpora, Text Normalization, Minimum Edit Distance. **N-Gram Language Models-**NGrams, Evaluating Language Models, Generalization and Zeros, Smoothing, Kneser-Ney Smoothing, The web and stupid Back off.	**CO1, CO2**
II	**Labeling for Parts of Speech-** English Word Classes, Part-of-Speech Tagging, Named Entities and Named Entity Tagging, HMM Part-of-Speech Tagging, Conditional Random Fields (CRFs), Evaluation of Named Entity Recognition.	**CO1, CO2**
III	**Formal Grammars of English-** Constituency, Context-Free Grammars, Some Grammar Rules for English, Treebanks, Grammar Equivalence and Normal Form, Lexicalized Grammars. **Syntactic Parsing-** Ambiguity, CKY Parsing: A Dynamic Programming Approach, Span-Based Neural Constituency Parsing.	**CO1,CO4**
IV	**Dependency Parsing-** Dependency Relations, Dependency Formalisms, Dependency Tree banks, Transition-Based Dependency Parsing, Graph- Based Dependency Parsing, Evaluation. **Representation of Sentence Meaning-** Computational Desiderata for Representations, Model- Theoretic Semantics, First-Order Logic, Event and State Representations, Description Logics.	**CO1, CO3**
V	**Semantic Parsing, Information Extraction-** Relation Extraction, Relation Extraction Algorithms, Extracting Times, Extracting Events and their Times, Template Filling. **Lexicons for Sentiment, Affect and Connotation-** Defining Emotion, Available Sentiment and Affect Lexicons, Creating Affect Lexicons by Human Labeling, Semi-supervised Induction of Affect Lexicons, Supervised Learning of Word Sentiment, Using Lexicons for Sentiment Recognition.	**CO1, CO3**

Learning Resources
Text Books
1. Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Daniel Jurafsky and James H Martin, Third Edition, 2020.
References
1. Natural Language Processing Recipes, Akshay Kulkarni, AdarshaShivananda, 2019, Apress. 2. Applied Text Analysis with Python, Benjamin Bengfort, Tony Ojeda, Rebecca Bilbro, 2018, O'Reilly Media. 3. Natural Language Processing: An information Access Perspective by Kavi Narayana Murthy, 2006, EssEss Publications. 4. Statistical Language Learning, Charniack, Eugene, 1993, MIT Press.
e-Resources and other Digital Material

1. https://web.stanford.edu/~jurafsky/slp3/
2. https://swayam.gov.in/nd1_noc19_cs56/preview
3. https://online.stanford.edu/courses/xcs224n-natural-language-processing-deep-learning
4. https://www.coursera.org/specializations/natural-language-processing

DISASTER MANAGEMENT AND PREPAREDNESS

Course Code	20CE2701A	Year	IV	Semester	I
Course Category	Open Elective	Branch	IT/ME/EEE/ECE/CE	Course Type	Theory
Credits	3	L – T – P	3-0-0	Prerequisites	20MC1301 – Environmental Science
Continuous Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes		
Upon successful completion of the course, the student will be able to:		
CO1	**Demonstrate** basic terminology and **classify** types of disasters	L3
CO2	**Outline** the impacts of disaster	L2
CO3	**Familiarize** Disaster management activities and phases	L2
CO4	**Explain** the Components of disaster relief, disaster management policies	L3
CO5	**Develop** the responsibilities towards society after disaster	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√	√					√			√				√
CO2	√	√					√			√				√
CO3	√	√					√			√				√
CO4	√	√					√			√				√
CO5	√	√					√			√				√

Syllabus

Unit No.	CONTENTS	Mapped CO
I	**INTRODUCTION & DISASTERS CLASSIFICATION** Concepts and definitions: disaster, hazard, vulnerability, resilience, risks severity, frequency and details, capacity, impact, prevention, mitigation. Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, forest fires.); manmade disasters (industrial pollution, nuclear radiation, chemical spills, terrorist strikes); hazard and vulnerability profile of India.	**CO1**
II	**DISASTER IMPACTS** Disaster impacts (environmental, physical, social, ecological, economical, political); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters	**CO2**

III	**DISASTER MITIGATION AND PREPAREDNESS** 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, Role of remote sensing and GIS in disaster management.	**CO3**
IV	**POST DISASTER RESPONSE** Emergency medical and public health services; Environmental post disaster response (water, sanitation, food safety, disease control, security, communications); reconstruction and rehabilitation; Roles and responsibilities of government, community, local institutions, role of agencies like NDMA, SDMA and other International agencies, organizational structure, role of insurance sector.	**CO4**
V	**DISASTERS - ENVIRONMENT AND DEVELOPMENT** Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land use changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods.	**CO5**

Learning Resources
Text Books
1. R. B. Singh, Disaster Management, Rawat Publications, 2000 2. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall. 3. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
Reference Books
1. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003 2. Inter-Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC
E-Resources & other digital material
1. http://ndma.gov.in/ (Home page of National Disaster Management Authority) 2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).

Research Methodology

Course Code	20EC2701A	Year	IV	Semester	I
Course Category	Open Elective	Branch	ECE	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	Nil
Continuous Internal Evaluation:	30	SemesterEnd Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand basic concepts and its methodologies (L2)
CO2	Demonstrate the knowledge of research processes (L3)
CO3	Apply research articles in their academic projects (L3)
CO4	Analyze various types of testing tools used in research (L4)
CO5	Design a research paper (L4)

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√							√		√		√		
CO2	√							√		√		√		
CO3	√							√		√		√		√
CO4		√			√	√		√		√		√	√	√
CO5		√						√		√		√		

Syllabus		
Unit No.	Contents	Mapped CO
1	**Introduction**: Meaning of Research, Objectives of Research, Types of Research, Research Approaches. **Research Ethics:** Objectives, codes, policies, conventions of publications, ethics for editors, reviewers and publishers, IPR. **Research Problem**: What is a Research Problem? , Selecting the Problem, Necessity of Defining a problem. Research Design –Features of Good Design, Important Concepts related to Research Design, Basic Principles of Experimental Designs.	CO1, CO2
2	**Sampling Design** –Sample Design, Sampling and Non-Sampling errors, Goodness of Measurement scales, Sources of error in measurement. **Data Collection Methods** – Collection of Primary Data –	CO1-CO3

	Collection of Secondary data. **Data Preparation**: Data Preparation Process, Some problems in Preparation Process, Missing Values and Outliers, Types of Analysis, Statistics in Research.	
3	**Descriptive Statistics**: Measures of Central Tendency, Measures of Dispersion, Measures of Skewness, Kurtosis, Measures of Relationship, Association in case of Attributes, Other Measures	CO1, CO4
4	**Sampling and Statistical Inference**: Parametric vs Statistic, Sampling and Non-Sampling errors, Sampling Distribution, Degrees of Freedom, Standard Error. **Testing of Hypothesis**: What is a Hypothesis, Basic Concepts Concerning Testing of Hypothesis, Testing the Hypothesis, Test Statistic and Critical Region, Critical Value and Decision Value, Procedure for Hypothesis Testing.	CO1, CO4
5	**Interpretation and Report Writing**: Meaning of Interpretation, Techniques of Interpretation, Precautions in Interpretation Significance of Report Writing, Different Steps in Writing Report, Layout of a Research Paper, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.	CO1, CO5

Learning Resources

Text Books

1. C.R.Kothari, Research Methodology: Methods and Techniques, 2nd Ed., New Age International Publishers,2014.
2. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, An introduction to Research Methodology, RBSA Publishers, U.K., 2002

Reference Books

1. Day, R.A., How to Write and Publish a Scientific Paper, Cambridge University Press,1992
2. Anthony, M., Graziano, A.M. and Raulin, M.L., Research Methods: A Process of Inquiry, Allyn and Bacon, 2009

e- Resources

1. https://www.youtube.com/watch?v=8iFfzYVuCuM
2. https://onlinecourses.nptel.ac.in/noc22_ge08
3. https://www.youtube.com/watch?v=GSeeyJVD0JU

E – WASTE MANAGEMENT

Course Code	**20EC2701B**	**Year**	IV	**Semester**	I
Course Category	Open Elective	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Understand the environmental impacts of e-waste. (L2)
CO2	Apply concepts of e-waste management hierarchy.(L3)
CO3	Distinguish the role of various national and internal act and laws applicable for e-waste management and handling.(L4)
CO4	Analyze the e – waste management measures proposed under national and global legislations. (L4)

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	√					√	√			√		√		√
CO2	√					√	√			√		√		√
CO3		√				√	√			√		√		√
CO4		√				√	√			√		√		√

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction.** E- waste; composition and generation. Global context in e-waste; E-waste pollutants, E waste hazardous properties, Effects of pollutant (E- waste) on human health and surrounding environment, domestic e-waste disposal, Basic principles of E waste management, Component of E waste management, Technologies for recovery of resources from electronic waste, resource recovery potential of e-waste, steps in recycling and recovery of materials-mechanical processing, technologies for recovery of materials, occupational and environmental health perspectives of recycling e-waste in India.	CO1
II	**E-waste hazardous on Global trade** Essential factors in global waste trade economy, Waste trading as a quint essential part of electronic recycling, Free trade agreements as a means of	CO1, CO2

	waste trading. Import of hazardous e-waste in India; India's stand on liberalizing import rules, E-waste economy in the organized and unorganized sector. Estimation and recycling of e-waste in metro cities of India.	
III	**E-waste control measures** Need for stringent health safeguards and environmental protection laws in India, Extended Producers Responsibility (EPR), Import of e-waste permissions, Producer-Public-Government cooperation, Administrative Controls & Engineering controls, monitoring of compliance of Rules, Effective regulatory mechanism strengthened by manpower and technical expertise, Reduction of waste at source.	CO1, CO3
IV	E-waste (Management and Handling) Rules, 2011; and E-Waste (Management) Rules, 2016 - Salient Features and its likely implication. Government assistance for TSDFs.	CO1, CO4
V	The international legislation: The Basel Convention; The Bamako Convention. The Rotterdam Convention. Waste Electrical and Electronic Equipment (WEEE) Directive in the European Union, Restrictions of Hazardous Substances (RoHS) Directive	CO1, CO4

Learning Resources
Text Books
1. Johri R., E-waste: implications, regulations, and management in India and current global best practices, TERI Press, New Delhi 2. Hester R.E., and Harrison R.M, Electronic Waste Management. Science, 2009
Reference Books
1. Fowler B, Electronic Waste – 1st Edition (Toxicology and Public Health Issues), 2017Elsevier
E-Resources
1. https://news.mit.edu/2013/ewaste-mit

NON-CONVENTIONAL ENERGY RESOURCES

Course Code	20EE2701A	**Year**	IV	**Semester**	I
Course Category	OE-III	**Branch**	Common to All	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the process of energy collection, quantification, storage, conversion and applications of non-conventional sources. **(L2)**
CO2	**Apply** the knowledge of energy conversion for harvesting energy from different sources like light, heat, wind etc. **(L3)**
CO3	**Apply** basic laws of physics for the production of energy from Solar, wind, ocean, biomass, geothermal, fuel cell and hydrogen energy sources. **(L3)**
CO4	**Analyze** the theory and designing wind mills, MHD, Fuel cells. **(L4)**
CO5	**Examine** the performance of solar and wind generating units and economic aspects of MHD biomass and Ocean energy sources. **(L4)**
CO6	**Ability** to apply the various energy generation techniques and to measure the **basic** parameters and **submit a report.**

Contribution Contribution of Course Outcomes towards achievement of Program Outcomes&bStrength of correlations (3: High, 2: Moderate, 1: Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1														
CO2	√						√						√	√
CO3	√						√						√	√
CO4		√											√	√
CO5		√					√						√	√
CO6									√	√		√	√	√

Syllabus

Unit No.	**Contents**	**Mapped CO's**
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 surface. Measurement of Solar Radiation: Pyrometer, shading ring pyrheliometer, sunshine recorder, schematic diagrams and principle of working.	CO1, CO2, CO3, CO6
II	SOLAR ENERGY COLLECTION AND STORAGE: Solar Light Energy: Photovoltaic effect, characteristics of photovoltaic cells, conversion efficiency, solar batteries and applications of photovoltaic energy conversion.	CO1, CO2 CO3, CO5,

	Solar Heat Energy: Sensible, latent heat of Heat storage, solar ponds. Applications- solar heating/cooling technique, solar distillation and drying.	CO6
III	**WIND ENERGY**: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria **OCEAN ENERGY:** OTEC, types of OTEC plants, mini-hydel power plants	CO1, CO2, CO3, CO4, CO5, CO6
IV	**BIO-MASS:** Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters. **GEOTHERMAL ENERGY:** Resources, methods of harnessing the energy.	CO1, CO3, CO5, CO6
V	**MHD Generators**: Basic principles of MHD generator and Hall Effect, different types of MHD generators. **Fuel Cells:** Introduction, principle of fuel cells, thermodynamic analysis of fuel cells, types of fuel cells, fuel cell batteries, applications of fuel cells.	CO1, CO3, CO4, CO6

Learning Resources
Text Books
1. G.D. Rai, Non-Conventional Energy Sources, Khanna publishers, 5th Ed., 2014. 2. S. Rao and B. B.Parulekar, Energy Technology- Non conventional, Renewable and Conventional , Khanna Pub ,3rd Ed., 1999.
Reference Books
1. Ashok V Desai, Non-Conventional Energy, New age publishers, 1st Ed., 1990. 2. B.H.Khan, Non-Conventional Energy Sources, Tata Mc Graw-hill Publishing Company, 2nd Ed., 2013. 3. B.T. Nijaguna, Biogas Technology, New Age International Pub, First edition 2002. 4. Tiwari and Ghosal, Renewable Energy resources, Narosa, 2nd Ed., 2005
Web links
1. https://www.coursera.org/learn/renewable-energy-technology-fundamentals 2. https://nptel.ac.in/courses/121106014

OPERATIONS RESEARCH

Course code	20ME2701A	Year	IV	Semester	I
Course category	Open Elective	Branch	Common to all	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	-
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the basics of linear programming, transportation, queueing , sequencing of jobs, replacement, inventory and simulation problems	L2
CO2	Apply linear programming, transportation and assignment models to solve real life problems	L3
CO3	Apply Sequencing, queueing, Game and Replacement theories to solve problems	L3
CO4	Apply knowledge of inventory control and simulation to solve practical industrial problems	L3

Contribution of Course Outcomes towards achievement of Program Outcomes& Strength of correlations (3: High, 2: Moderate, 1: Low)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√	√								√	√		√	√
CO2	√	√								√	√		√	√
CO3	√	√								√	√		√	√
CO4	√	√								√	√		√	√

Syllabus		
UNIT No.	Contents	Mapped CO
I	**Introduction to Operations Research:** History, definition, operations research models, phases of implementing operations research in practice, applications. **Linear Programming**: Introduction, formulation, graphical solution, simplex method, artificial variable techniques – Big M and two-phase methods, duality principle.	CO1 CO2
II	**Transportation**: Formulation, initial feasible solution, optimal solution – MODI method, unbalanced transportation problems, degeneracy in transportation problems. **Assignment**: Formulation, optimal solution, Hungarian method, travelling salesman problem.	CO1 CO2
III	**Queuing theory**: Introduction, Kendall's notation, classification of	CO1

	queuing models, single server and multi-server models, Poisson arrival, exponential service, infinite population **Sequencing**: Introduction, assumptions, processing n-jobs through two machines, n-jobs through three machines, and graphic solution for processing 2 jobs through n machines with different order of sequence.	**CO3**
IV	**Game Theory**: Introduction, game with pure strategies, game with mixed strategies, dominance principle, graphical method for 2xn and mx2 games. **Replacement Theory**: Introduction, replacement of items that deteriorate with time - value of money unchanging and changing, simple probabilistic model for replacement of items that fail completely	**CO1** **CO3**
V	**Inventory control**: Introduction, inventory costs, Economic Order Quantity (EOQ)Demand rate Uniform and replenishment rate infinite, demand rate non-uniform replenishment rate infinite, Demand rate uniform, models with and without shortages, inventory model with single price break. **Simulation**: Definition, Types of simulation models, phases of simulation, applications of simulation	**CO1** **CO4**

Learning Resource
Text books:
1. Operations Research, by S.D.Sharma, Kedarnath & Ramnath publications (15th edition),2013. 2. Introduction to Operations Research, by Taha, Pearson Education,New Delhi, (8th edition), 2008
Reference books
1. Operations Research, (4th edition) by A.M .Natarajan, P. Balasubramani, ATamilarasi, Pearson Education, New Delhi, 2009. 2. Operations Research, (2nd edition) by R.Pannerselvam, 2009,PHI Publications, Noida 3. Operations Research, (2nd edition) by Wagner, 2007, PHI Publications, Noida 4. Operation Research, (4th edition) by J.K.Sharma, 2009, MacMilan publishers, india Ltd. New Delhi.
E-Resources & other digital Material:
1. http://nptel.ac.in/courses/112106134/ 2. http://nptel.ac.in/courses/112106131/

MANAGEMENT INFORMATION SYSTEMS

Course Code	20ME2701B	**Year**	IV	**Semester**	I
Course Category	Open Elective	**Branch**		**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	--
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Discuss the basic concepts of MIS, Decision making, Applications of MIS, Decision support systems, BPR and E- Commerce.	L2
CO2	Interpret the MIS decision making and its applications.	L3
CO3	Categorise Decision support systems and Business Process Re-Engineering	L3
CO4	Summarise the Electronic commerce environment and its opportunities.	L3

Contribution of Course outcomes towards achievement of Program outcomes & Strength of correlations (High:3, Medium: 2, Low:1)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√	√			√			√	√	√	√	√	√	√
CO2	√	√			√			√	√	√	√	√	√	√
CO3	√	√			√			√	√	√	√	√	√	√
CO4	√	√			√			√	√	√	√	√	√	√

Syllabus		
UNIT No.	**Contents**	**Mapped CO**
I	**Introduction to MIS**: Definition of MIS, Role and Impact of MIS, MIS: Support to the management, As tool for Management Process, Basic model of organization, Modifications to the basic model, organization as a system, MIS: organization, Strategic management of business.	CO1
II	**Decision Making:** Concepts, Methods, Tools, Procedures, Organizational decision making, MIS and Decision making concepts, Information: A Quality Product, Classification of information, Value of information, General model of Human as information processor, Types of systems, Handling system complexity, Development of long range plans of the MIS, Development and implementation of MIS, Factors of Success and failure for MIS.	CO1, CO2
III	**Applications:** Applications in Manufacturing Sector, Personnel, financial, production, materials, marketing management, Applications in service sector, creating a Distinctive service, MIS in service industry,	CO1, CO2

	Technology of Information systems, Data processing, Transaction processing, Application processing, TQM of Information systems, Programming languages for system coding.	
IV	**Decision support systems and BPR:** Concept and philosophy, Deterministic systems, Artificial Intelligence systems, Knowledge based expert system, Enterprise Management systems, ERP basic features EMS and MIS, Business Process Re- Engineering, Process model of organization, Value stream model of the organization MIS and BPR.	**CO1, CO3**
V	**E-Commerce:** Electronic commerce environment and opportunities: back ground, electronic commerce Environment, Modes of electronic commerce: Approaches to safe electronic commerce, Overview, Secure transport protocols, Secure Transactions, Secure Electronic Payment Protocol, and Secure Electronic Transaction.	**CO1, CO4**

Learning Resource
Text books:
1. W.S. Jawadekar, Management Information Systems: A Global Digital Enterprise Perspective, 5th Edition, McGraw Hill Education, 2013. 2. D. Minoli, Web Commerce Technology Hand Book, 1st edition, McGraw Hill Education, 2000.
Reference books
1. K.C. Laudon and J. Laudon, Management Information Systems: Managing a Digital firm, 11t^{h} Edition, Pearson Education, 2012. 2. D. Gordon and M. Oslon, Management Information Systems: Conceptual Foundations, Structure and Development, 2nd Edition, McGraw Hill Education Pvt Ltd, India, 2001. 3. R.G. Murdic, J.E. Ross and J.R. Clagget, Information Systems for Modern Management, 3rd Edition, PHI, 2008. 4. K.Ravi and A.B. Whinston, Frontiers of Electronic Commerce, 1st edition, Pearson India, 2002.
E-Resources & other digital Material:
1. http://nptel.ac.in/courses/112106134/ 2. http://nptel.ac.in/courses/112106131/

20CE2702A - ENVIRONMENTAL MANAGEMENT AND AUDIT

Course Category:	Open Elective -IV	Credits:	3
Course Type:	Theory	Lecture-Tutorial-Practical:	3-0-0
Prerequisites:	Environmental Science	Continuous Evaluation:	30
		Semester End Evaluation:	70
		Total Marks:	100

Course Outcomes

Upon successful completion of the course, the student will be able to:

CO1	**Apply** basic knowledge on solid waste management	L3
CO2	**Analyze** the various hazards, handling techniques and disposal methods of biomedical waste	L4
CO3	**Design** E-waste disposal procedures for different E- waste.	L3
CO4	**Outline** the basic principles and importance of EIA and analyze the effect of developmental activities on the environment	.L4
CO5	**Understand** the activities in environmental auditing and applying them to industries to improve their environmental impact and sustainability performance.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√	√	√				√						√	√
CO2	√	√	√				√						√	√
CO3	√	√	√				√						√	√
CO4	√	√	√				√						√	√
CO5	√	√	√				√						√	√

Course Content

UNIT-1	**INTRODUCTION TO SOLID WASTE MANAGEMENT** Sources and types of municipal solid wastes-waste generation rates-factors affecting generation, characteristics, segregation of solid wastes – source reduction of waste – objectives of waste processing, elements of solid waste management – public role in solid waste management.	CO1
UNIT-2	**BIOMEDICAL WASTE MANAGEMENT** Definition-Sources-Classification of biomedical waste – Objectives of Biomedical waste management-segregation-containers for biomedical waste-Labelling Collection-Transport-Disposal methods	CO2
UNIT-3	**E-WASTE MANAGEMENT** E-waste: Sources- Types- components; Collection process- Segregation-Disposal methods; Effect on air, water and soil; Health hazards; Role of individual for E-waste management. Current E-waste Management Rules	CO3
UNIT-4	**ENVIRONMENTAL IMPACT ASSESSMENT (EIA)** Introduction-Definition-Scope-Objectives of EIA-Basic EIA Principles, Classification of EIA-Life Cycle Assessment-Environmental Policy of India. Baseline Data Acquisition: Environmental Inventory- Rapid EIA.	CO4
UNIT-5	**ENVIRONMENTAL AUDIT INTRODUCTION** Environmental audit Significance for Industry-Elements of Environmental audit. Process of environmental audit-Pre audit- Activity -Activities at site- Post audit.	CO5

Learning Resources

Text Books	1. Agarwal, K.M., Sikdar, P.K., Deb., S.C (2005) A Text Book of Environment, Macmillan IndiaLimited. 2. Sharma, R.D. (1976), Organisational Management, Light and Life Publishers,

	New Delhi. 3. Varma and Agarwal, Theory & practice of Management Forward BookDepot, NewDelhi
Reference Books	1. Kovntz, H and C. Danvel (1978): Essential of management, second edition, Tata Mc Graw Hillpublishing company, New Delhi. 2. Erickson, P.A. (1977) Environmental Impact Assessment – Principles and Erickson,P.A. (1977)
E-Resources & other digital material	**http://nptel.ac.in**

TELECOMMUNICATIONS

Course Code	**20EC2702A**	**Year**	IV	**Semester**	I
Course Category	Open Elective-IV	**Branch**	ECE	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	--
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Infer the basic knowledge of telecommunication system, regulations (L2).
CO2	Make use of revolutionary changes in Tele Communication technologies (L3).
CO3	Analyse different components of tele communication system. (L4).
CO4	Appraise the use of various components of telecommunication systems (L4).

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO 1	PSO 2
CO1	√													
CO2	√									√				
CO3		√								√			√	√
CO4		√								√			√	√

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Telecommunication Systems:** Evolution of Tele Communication Systems, Simple telephone communication, Telephones, Telephone System, Facsimile, Internet Telephony, Tele Communication Standards.	CO1 –CO4
II	**Cell Phone Technologies**: Cellular Telephone Systems, A Cellular Industry Overview, 2G and 3G Digital Cell Phone Systems, Long Term Evolution and 4G Cellular Systems	CO1 –CO4
III	**Wireless Technologies:** Wireless LAN, PANs and Bluetooth, ZigBee and Mesh Wireless Networks,WiMAX and Wireless Metrop olitan-Area Networks- Infrared wireless- Ultra wideband wireless- Additional wireless applications	CO1 –CO4

IV	**Optical Communication:** Optical Principles, Optical Communication Systems, Fiber-Optic Cables, Optical Transmitters and Receivers.	CO1 –CO4
V	**Satellite Communication:** Satellite Orbits, Satellite Communication Systems, Satellite Subsystems, Ground Stations, Satellite Applications, Global Navigation Satellite Systems.	CO1 –CO4

Learning Resources
Text Books
1. Louis E. Frenzel Jr., Principles of Electronic Communication Systems, 4/e, Mc Graw Hill Publications, McGraw-Hill Education, 2016. 2. Telecommunication Switching Systems and Networks, by Thiagarajan Viswanathan, PHI
Reference Books
1. Telecommunication Switching and Networks. By P.Gnanasivam, New Age International 2. Willium C. Y. Lee, “Wireless & Cellular Telecommunications”, McGraw-Hill Companies Inc, Third Edition, 2006.1. 2. Wayne Tomasi, Advanced Electronic Communication Systems, 4/e, Pearson Education, 2013. 3. Dennis Roddy, Electronic Communications, 4/e, Pearson Education, 2003.

SATELLITE COMMUNICATIONS

Course Code	20EC2702 B	Year	IV	Semester	I
Course Category	OE-III	Branch	ECE	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	--
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Illustrate** the basic concepts of satellite communication and different Frequency allocations for satellite services. (L2)
CO2	**Analyze** the satellite orbits and link design for transmission & reception of signals (L4)
CO3	**Analyze** various satellite subsystems and its functionality. (L4)
CO4	**Choose** appropriate multiple access technique for a given satellite communication application (L3)

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√									√				√
CO2		√								√				√
CO3		√								√				√
CO4	√									√				√

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction:** Historical Back-ground, Basic Concepts of Satellite Communications, Frequency allocations for Satellite Services, Applications.	CO1
II	**Orbital Mechanics And Launchers:** Orbital Mechanics, Look Angle determination, Orbital perturbations, Orbit determination, launches and launch vehicles, Orbital effects in communication systems performance.	CO1, CO2
III	**Satellite Subsystems:** Attitude and orbit control system, telemetry, tracking, Command and monitoring, power systems, communication subsystems, Satellite antenna Equipment reliability and Space qualification.	CO1, CO3
IV	**Satellite Link Design:** Basic transmission theory, system noise temperature and G/T ratio, Design of down links, up link design, Design of satellite links for specified C/N, System design example.	CO1, CO2
V	**Multiple Access:** Frequency division multiple access (FDMA) Intermodulation, Calculation of C/N. Time division Multiple Access (TDMA) Frame structure, Examples. Satellite Switched TDMA On-board processing, DAMA, Code Division Multiple access (CDMA).	CO4

Learning Resources

Text Books

1. Satellite Communications – Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2rd Edition, 2003
2. Satellite Communications Engineering – Wilbur L. Pritchard, Robert A Nelson and Henri G.SuyderhoudPearson Publications, 2nd Edition, 2003.

Reference Books

1. Satellite Communications : Design Principles - M. Richharia, BS Publications, 2rd Edition, 2003
2. Satellite Communication - D.C Agarwal, Khanna Publications, Mc.Graw Hill, 5th Edition, 2008.
3. Fundamentals of Satellite Communications – K.N. Raja Rao, PHI, 2004.
4. Satellite Communications – Dennis Roddy, McGraw Hill, 2nd Edition, 1996

e- Resources & other digital material

1. https://nptel.ac.in/courses/117/105/117105131/3.https://nptel.ac.in/courses/108/105/108105159/

UTILIZATION OF ELECTRICAL POWER

CourseCode	20EE2702A	**Year**	IV	**Semester**	I
Course Category	OE-IV	**Branch**	Common to all	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	--
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the utilization of electrical systems and their advantages in industrial applications. (L2)
CO2	**Apply** the knowledge to select suitable motor for electric drives, appropriate heating / welding techniques and Illumination systems in various industrial applications. (L3)
CO3	**Apply** the knowledge to select suitable track electrification system and traction motors. (L3)
CO4	**Analyze** the concepts of electric drives, different heating/welding techniques and various Illumination systems for industrial applications. (L4)
CO5	**Analyze** the performance parameters of speed-time curves for different services and the mathematical concepts to design traction system. (L4)
CO6	**Submit a report** on electric drives, electric heating & welding, illumination and electric traction system.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1														
CO2	√					√								
CO3	√						√							
CO4		√				√								
CO5		√					√							
CO6		√				√			√	√				

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Electric Drives** Type of electric drive, choice of motor, starting and running characteristics, speed control, temperature rise of electrical machines, heating-time and cooling-time curves, selecting motor power rating for continuous, intermittent and short timeduty, types of industrial loads, applications of electric drives.	**CO1** **CO2** **CO4** **CO6**
II	**Electric Heating & Electric Welding** Advantages and methods of electric heating, methods of heat transfer, Stefan's law, design of heating elements, resistance heating, construction	**CO1** **CO2**
	and working principle of induction furnaces, arc furnaces and dielectric heating. Types of welding, resistance and arc welding, comparison between A.C and D.CWelding.	**CO4** **CO6**

III	**Illumination** Introduction, Terms used in illumination, laws of illumination, sources of light, Incandescent lamps, Discharge lamps, MV and SV lamps, fluorescent lamps- CFL-LED lamps, Types of lighting schemes, factory lighting, flood lighting and street lighting.	**CO1** **CO2** **CO4** **CO6**
IV	**Electric Traction-I** Systems of electric traction and systems of track electrification, special featuresof traction motors, methods of electric braking-plugging, rheostat braking and regenerative braking, Speed-time curves for different services- trapezoidal and quadrilateral speed time curves.	**CO1** **CO3** **CO5** **CO6**
V	**Electric Traction-II** Mechanics of train movement, Calculations of tractive efforts and power outputof traction motor, Specific energy consumption for given run, effect of varying acceleration and braking retardation, dead weight, accelerating weight, adhesive weight and coefficient of adhesion, Current collectors for overhead system.	**CO1** **CO3** **CO5** **CO6**

Learning Resources
Text Books:
1. H. Partab, "Art & Science of Utilization of Electrical Energy", Dhanpat Rai & Sons, 12th edition, 2012. 2. E. Openshaw Taylor, "Utilization of Electrical Energy", Orient Longman, 15th edition, 2012.
Reference Books:
1. J.B.Gupta, "Utilization of Electric Power and Electric Traction", S.K. Kataria & Sons, 10th edition, 2012. 2. C.L.Wadhwa, "Generation, Distribution and Utilization of Electrical Energy", New Age international (P) Limited Publishers, 2015.
e- Resources
https://nptel.ac.in/courses/108105060

MECHATRONICS

Course Code	20ME2702A	Year	IV	Semester	I
Course Category	Open Elective-4	Offering Branch	ME	Course Type	Theory
Credits	3	L – T – P	3 – 0 – 0	Prerequisites	Basic electrical and electronics
Continuous Internal Evaluation	30	Semester End Evaluation	70	Total Marks	100

	Statement	BTL	Units
CO1	Explain the concepts related to elements of Mechatronic systems.	L2	1,2,3,4,5
CO2	Summarize the construction and working of sensors used in building mechatronic systems.	L3	1
CO3	Illustrate various types of actuation systems and their components.	L3	2
CO4	Develop mathematical models using building blocks and make use of these models to find the dynamic response.	L3	3
CO5	Summarize the construction and working of closed loop controllers, Micro processor and Microcontrollers.	L3	4
CO6	Illustrate the features and applications of digital logic, PLC and of Fuzzy logic.	L3	5

Contribution of Course outcomes towards achievement of Program outcomes &Strength of correlations

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√									√		√	√	√
CO2	√									√		√	√	√
CO3	√		√							√		√	√	√
CO4	√	√			√					√		√	√	√
CO5	√				√					√		√	√	√
CO6	√				√					√		√	√	√

Syllabus		
UNIT	Contents	Mapped CO
I	**INTRODUCTION:** Definition of Mechatronics, evolution of mechatronics, systems, measurement systems, control systems, mechatronic design process, traditional design and mechatronic design, applications of mechatronic systems, advantages and disadvantages of mechatronic systems. **SENSORS:** classification of sensors, basic working principles, Velocity sensors – Proximity and Range sensors, ultrasonic sensor, laser interferometer transducer, Hall Effect sensor, inductive proximity switch. Light sensors – Photodiodes, phototransistors, tactile sensors –PVDF tactile sensor, micro-switch and reed switch, Piezoelectric sensors, vision sensor	CO1 CO2

II	**PNEUMATICAND HYDRAULIC ACTUATION SYSTEMS:** Actuation systems, Pneumatic and Hydraulic systems- constructional details of filter, lubricator, regulator, direction control valves, pressure control valves, flow control valves, actuators-linear and rotary. **ELECTRICAL ACTUATION SYSTEMS**: Electrical systems, Mechanical switches, solid state switches, solenoids, DC motors, AC motors, stepper motors. Characteristics of pneumatic, hydraulic, electrical actuators and their limitations.	**CO1 CO3**
III	**BASIC SYSTEM MODELS:** Mathematical models, mechanical system building blocks, electric system building blocks, fluid system building blocks, thermal system building blocks. **DYNAMIC RESPONSES OF SYSTEMS:** Transfer function, Modelling dynamic systems, first order and second order systems.	**CO1 CO4**
IV	**CLOSED LOOP CONTROLLERS:** Classification of control systems, feedback, closed loop and open loop systems, continuous and discrete processes, control modes, two step mode, proportional mode, derivative control, integral control, PID controller. **MICROPROCESSOR AND MICRO CONTROLLER:** Introduction, Architecture of a microprocessor (8085), Architecture of a Micro controller, Difference between microprocessor and a microcontroller.	**CO1 CO5**
V	**DIGITAL LOGIC:** Digital logic, number systems, logic gates, Boolean algebra, Karnaugh maps, application of logic gates, sequential logic, transducer Signal Conditioning and devices for data conversion. **PROGRAMMABLE LOGIC CONTROLLERS:** Introduction, basic structure, input/output processing, programming, mnemonics, timers, internal relays and counters, shiftregister,masterandjumpcontrols.Datahandling,Analoginput/output,selectionofaPLC. **FUZZY LOGIC APPLICATIONS IN MECHATRONICS**: Fuzzy logic systems, Fuzzy control, Uses of Fuzzy expert systems.	**CO1 CO6**

Learning Resource
Text books:
1. Mechatronics Electronic Control Systems in Mechanical and Electrical Engineering, (3rdedition), by WBolton, Pearson Education Press, 2005. 2. Mechatronics System Design, 5thIndian reprint, 2009, by Devdas shetty, Richard A.kolk, PWS Publishing Company
Reference books
1. Mechatronics Sou rce Book, by Newton C Braga, Thomson Publications, Chennai. 2. Mechatronics, by N. Shanmugam, Anuradha Agencies Publishers. 3. Control sensors and actuators, by C. W. Desilva, Prentice Hall. 4. Design with Micro processors for Mechanical Engineers, by Stiffler, A. K. McGraw-Hill(1992).
E-Resources & other digital Material:
1. https://onlinecourses.nptel.ac.in/noc22_me54/course

ROBOTICS

Course code	20ME2702B	Year	IV	Semester	I
Course category	Open Elective-4	Offering Branch	ME	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	Nil
Continuous Internal Evaluation	30	Semester End Evaluation	70	Total Marks	100

Course Outcomes: Upon successful completion of the course, the student will be able to

	Statement	Skill	Level	Units
CO1	Understand the basic anatomy of robots, actuators, end effectors, robot sensors, programming and applications.	Understand	L2	1,2,3,4,5
CO2	Understand the working principles of robot actuators, end effectors	Understand	L2	2
CO3	Apply robot programming skills	Apply, Modern Tool Usage	L3	3
CO4	Apply knowledge of robot sensors and their applications in industries	Apply	L3	4,5

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√												√	√
CO2	√	√											√	√
CO3	√	√	√		√								√	√
CO4	√		√										√	√

Syllabus		
UNIT	**Contents**	**Mapped COs**
I	**Introduction:** Automation and robotics – History of robots -Robot anatomy – classification of robots, major components-robot specifications, selection of robots.	**CO1**
II	**Robot actuators-** Pneumatic, Hydraulic actuators, electric & stepper motors **End Effectors**- types of end effectors, grippers and tools, Requirements and challenges of end effectors.	**CO1, CO2**
III	**Robot Programming: -** Robot programming languages - programming methods - off and on-line programming - Lead through method - Teach pendent method, simple programs.	**CO1, CO3**
IV	**Sensors used in robots:** Sensor devices, Types of sensors - contact, position and displacement sensors, Force and torque sensors - Proximity and range sensors - acoustic sensors –slip sensors, Robot vision systems	**CO1, CO4**
V	**Applications of robots:** Application of robots in industry - material handling, processing operations, assembly, and inspection operations.	**CO1, CO4**

Learning Resource
Text books:
1. Mikell P. Groover. Industrial Robotics Technology Programming and Applications, McGraw Hill Co., Singapore, 1995. 2. Robotic Engineering by Richard D.Klafter, Prentice Hall
Reference books
1. Introduction to Robotics – Saeed B.Niku, Prentice Hall 2. Introduction to Robotics – John J. Craig, Addison Wesley
E-Resources & other digital Material:
1. http://nptel.ac.in/downloads/112101098/

ENTREPRENEURSHIP MANAGEMENT

Course Code	**20HS7701C**	**Year**	IV	**Semester**	I
Course Category	Humanities and Social Science Electives	**Offering Branch**	ME	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes: Upon successful completion of the course, the student will be able to

	Statement	Skill	BTL	Units
CO1	Understand the basic concepts and factors for starting and successful running of different forms of an enterprise.	Understand	L2	1,2,3,4,5
CO2	Describe characteristics, values and attitudes of an entrepreneur.	Understand	L2	2
CO3	Illustrate different forms of Entrepreneurial structures and Intrapreneurship.	Application	L3	3,4
CO4	Summarize critical Factors for starting a new enterprise and ethics to be followed during running of enterprise.	Application	L3	5

Contribution of Course outcomes towards achievement of Program outcomes &Strength of correlations

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√		√			√			√		√	√		
CO2	√		√			√			√		√	√		
CO3	√		√			√			√		√	√		
CO4	√		√			√		√	√		√	√		

Syllabus

UNIT	Content	Mapped CO
I	**Introduction to Entrepreneurship**: Meaning, Nature, origin and development of entrepreneurship in India, Need and Importance, Core elements, Principles, Essentials, Types, Functions, Concept of entrepreneurship management, Motives behind being an entrepreneur, Entrepreneurial Process.	CO1
II	**Entrepreneurial Values and Attitudes**: Introduction to entrepreneurial Values and Attitudes, Dominant characteristics of successful entrepreneurs, Internal and external factors for entrepreneurial motivation, Entrepreneurial Skills, Identifying business opportunities. **Role of creativity in Entrepreneurship-** the creative process, the Innovation process, types of innovation, sources of innovation, principles of innovation, Sources of Business Ideas.	CO1, CO2

III	**Forms of Entrepreneurial structures**: Sole Proprietorship-meaning, merits and limitations, Partnership-Meaning, Forms, merits and limitations. **Corporations**-Meaning, merits and limitations, Limited Liability partnerships and corporations, Franchising-Meaning, types, merits and limitations.	**CO1, CO3**
IV	**Intrapreneurship**: Meaning, Characteristics, Intrapreneurs Activities, types of Corporate Entrepreneurs, Corporate V/s Intrapreneurial culture, Climate, Fostering Intrapreneurial culture. **Promoting intrapreneurship**- Pinchot's Spontaneous teams and Formal Venture teams, establishing intrapreneurial ventures.	**CO1, CO3**
V	**Critical Factors for starting a new enterprise**: Personal, Environmental, Sociological factors, Problems of a new venture-Financial, administrative, marketing, production and other problems **Ethics and Entrepreneurship**: Defining Ethics, Approaches to Managerial ethics, ethics and business decisions, Ethical practices and code of conduct, Ethical considerations in corporate entrepreneurship.	**CO1, CO4**

Learning Resources
Text Books
1. Entrepreneurship development, Moharanas and Dash C.R., RBSA Publishing, Jaipure. 2. Beyond entrepreneurship, Collins and Lazier W, Prentice Hall, New Jersey, 1992. 3. Entrepreneurship, Hisrich Peters Sphephard, Tata McGraw Hill. **4.** Fundamentals of entrepreneurship, S.K. Mohanty, Prentice Hall of India.
Reference Books
1. Small scale industries and entrepreneurship, Dr. Vasant Desai, Himalayan Publishing House. 2. Management of small scale industries, Dr. Vasant Desai, Himalayan Publishing House. 3. Management of small scale industries, J.C. Saboo Megha Biyani, Himalayan Publishing House. 4. A Guide to Entrepreneurship, David Oates, Jaico Publishing House, Mumbai, Edn 2009.
E-Resources & other digital Material
1. https://onlinecourses.swayam2.ac.in/cec20_mg19/preview 2. https://onlinecourses.swayam2.ac.in/ntr22_ed08/preview

INDUSTRIAL ENGINEERING MANAGEMENT

Course Code	20HS7701F	**Year**	IV	**Semester**	I
Course Category	**Humanities and Social Science Electives**	**Offering Branch**	ME	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation:	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes: Upon successful completion of the course, the student will be able to				
	Statement	**Skill**	**BTL**	**Units**
CO1	Understand the basic concepts of management, organizational structures, leadership, operations management and project management.	Understand	L2	1,2,3,4,5
CO2	Explain the leadership qualities and concept of plant layout.	Understand	L2	2
CO3	Apply different quality control techniques.	Apply	L3	3
CO4	Illustrate various operations management Techniques	Apply	L3	4
CO5	Solve operations management and project management problems	Apply	L3	5

Contribution of Course outcomes towards achievement of Program outcomes &Strength of correlations

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√					√		√			√			√
CO2	√					√		√			√			√
CO3	√					√		√			√			√
CO4	√					√		√			√			√
CO5	√					√		√			√			√

Syllabus		
UNIT	**Contents**	**Mapped CO**
I	**INTRODUCTION**: Definition of Industrial Engineering, Applications, Role of Industrial Engineer, Quantitative tools of IE, Functions of Management, Taylor's Scientific Management, Fayol's Principles of Management, Douglas Mc-Gregor's Theory X and Theory Y, Hertzberg's Two Factor Theory of Motivation, Maslow's Hierarchy of Human Needs. **ORGANISATIONAL STRUCTURES**: Basic concepts related to Organization – Depart mentation and Decentralization, Flat and Tall organizations, Organizational chart, Line organization, Line and staff organization, functional organization	**CO1**
II	**LEADERSHIP**: Introduction, Definition, Types of leadership based on authority- their area of applicability and suitability, advantages and limitations, Traits approach to leadership **PLANT LOCATION**: Definition, factors affecting the plant location, comparison of rural and urban sites. Plant Layout – definition, objectives, types of production, types of plant layout – various data analyzing forms-travel chart.	**CO1, CO2**

III	**INSPECTION AND QUALITY CONTROL**: Types of inspections, Statistical Quality Control techniques, variables and attributes, assignable and non-assignable causes. **Control Charts:**variable control charts- X -bar and R charts, Attribute control charts- P-charts and C-charts. **Acceptance sampling-** Single Sampling, Double sampling, Multiple Sampling, OC curves.	**CO1, CO3**
IV	**WORK STUDY**: Definition, objectives, method study - definition, objectives, steps involved- various types of associated charts-out line process charts, flow process charts, two handed process charts and SIMO charts. **TIME STUDY**: definition, time study, steps involved-equipment, different methods of performance rating- allowances, standard time calculation.	**CO1, CO4**
V	**PROJECT MANAGEMENT**: Network modeling, Probabilistic model-various types of activity times estimation, programme evaluation review techniques (PERT), probability of completing the project, **Deterministic model-** critical path method (CPM), critical path calculation, crashing of simple of networks.	**CO1, CO5**

Learning Resources
Text Books:
1. S.Bhaskar, "Management Science", Anuradha Publications 2. O.P. Khanna, "Industrial Engineering and Management", DhanpatRai 3. T. R. Banga, S. C. Sharma, N. K. Agarwal, "Industrial Engineering and Management Science" Khanna Publishers.
Reference Books:
1. PannerSelvam, Production and Operations Management, PHI, 2004. 2. Ralph M Barnes, Motion and Time Studies, John Wiley and Sons, 2004. 3. Chase, Jacobs, Aquilano, Operations Management, TMH 10th Edition, 2003. 4. L.S.Srinath, PERT / CPM, affiliate East-West Press, New Delhi, 2000. 5. Phillip Kotler, Marketing Management, Pearson, 2004. 6. S. Bhaskar, "Management Science" Anuradha Publications.

Salesforce Technologies

Course Code	20SA8755	**Year**	IV	**Semester**	I
Course Category	SOC	**Branch**	CSE	**Course Type**	Theory/Practical
Credits	2	**L-T-P**	1-0-2	**Prerequisites**	Fundamentals in any programming language
Continuous Internal Evaluation:	-	**Semester End Evaluation:**	50	**Total Marks:**	50

Course Outcomes		
Upon Successful completion of course, the student will be able to		
CO1	Apply basics of CRM, multi-tenancy, Data modelling and management in Sales force for solving problems in Apex.	**L3**
CO2	Implement programming constructs of Apex like class, interface triggers as an individual on different IDEs/ online platforms.	**L3**
CO3	Develop an effective report based on various programs implemented.	**L3**
CO4	Apply technical knowledge for a given problem and express with an effective oral communication.	**L3**
CO5	Analyze outputs using given constraints/test case/ debugging and deployment tools of Sales force.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3: High, 2: Medium, 1: Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		√											√	
CO2					√				√					
CO3										√				
CO4									√		√			
CO5			√			√								

Syllabus		
Unit No	**Contents**	**Mapped CO**
I	**Sales force Fundamentals:** What is a multi-tenancy, consideration, MVC paradigm, Core CRM objects? **Data Modeling and Management:** Data modeling, Relationship types, Visualizing and creating entity relationships, Importing and exporting data into development environments. **Practical Exercises:** 1. Create, setup Salesforce developer account and access developer console. 2. Exercise on Standard and custom objects, Relationship fields. 3. Exercise on how to import and export data.	**CO1, CO2, CO3, CO4, CO5**
II	**Apex:** Apex Basics, Class and instance, Features of Apex, Apex variables, constants and expressions, Access modifiers, Control flow statements, working with data in salesforce. **Practical Exercises:** 1. Exercise on install Force.com IDE and create projects. 2. Exercise on primitive datatypes, sObject, Enum and collections. 3. Exercise on control statements and looping statements.	**CO1, CO2, CO3, CO4, CO5**
III	**Apex Classes, Interfaces & Triggers:** Apex classes, interfaces, Apex triggers, sObject relationships, Implementing SOQL & SOSL queries, the order of execution, Exception handling, Security in Apex, Web service callouts **Practical Exercises:** 1. Exercise on creating Apex class. 2. Exercise on SOQL and SOSL Queries. 3. Exercise on working with Apex Triggers.	**CO1, CO2, CO3, CO4, CO5**
IV	**Salesforce user interface:** Introduction, Displaying Salesforce data using Visualforce, Lightning component framework, Benefits of Lightning component framework, Resources in Lightning component. **Practical Exercises:** 1. Exercise on displaying data using Visualforce and Visualforce pages. 2. Practice components in Lightning component framework.	**CO1, CO2, CO3, CO4, CO5**
V	**Debugging and Deployment tools:** Debugging and Deployment tools, Monitoring and accessing debug logs, deploying metadata to another org. **Practical Exercises:** 1. Exercise on creating sandbox and deployment strategies.	**CO1, CO2, CO3, CO4, CO5**

Learning Resources
Text Books
1. Salesforce Platform Developer I Certification Guide, John Vandevelde, Gunther Roskams, Packt Publishing.
References
1. Beginning Salesforce Developer, Michael Wicherski, Apress.
e-Resources and other Digital Material
1. Salesforce Platform Developer I, Trail: https://trailhead.salesforce.com/content/learn/trails/platform-developer-i-certification-study-guide

Internship

Course Code	**20CS3781B/C**	**Year**	**IV**	**Semester**	**I**
Course Category		**Branch**	**CSE**	**Course Type**	**Practical**
Credits	**3**	**L-T-P**	**0-0-0**	**Prerequisites**	**-**
Continuous Evaluation :	-	**Semester End Evaluation:**	**50**	**Total Marks:**	**50**

Course Outcome		
Upon successful completion of the course, the student will be able to		
CO1	Apply domain knowledge during the course of internship.	**L3**
CO2	Demonstrate effective oral communication skills.	**L3**
CO3	Work as an individual or a team member in a collaborative environment.	**L3**
CO4	Exhibit integrity and ethical behavior while carrying out the internship	**L3**
CO5	Apply effective time management skills to complete the work within appropriate time.	**L3**
CO6	Develop an effective report based on the work completed during the internship.	**L3**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO1 2**	**PSO 1**	**PSO 2**
CO1													√	
CO2										√				
CO3									√					
CO4								√						
CO5											√			
CO6										√				

Fundamentals of Full Stack Web Development

Course Code	20CS6721	**Year**	IV	**Semester**	I
Course Category	Honors	**Branch**	**CSE**	**Course Type**	Theory
Credits	4	**L-T-P**	4-0-0	**Prerequisites**	Programming with Java, Web Technologies
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand fundamental concepts of web application development	**L2**
CO2	Apply the concepts of user interface to develop front end of web application	**L3**
CO3	Apply concepts of database to develop web application	**L3**
CO4	Analyze the Front End and Back-End Technologies to develop and host Web Application	**L4**

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Intro to HTML:** Browser to browser differences, Tags, Attributes and elements, DocType Element, Comments, Headings, Paragraphs, Formatting text, Lists, Links, Images and Table, **Intro CSS-** selectors , properties, values, color , backgrounds, pop-box (model box), Padding, margin, Applying styles via classes, id, tags, Bootstrap	**CO1, CO2**
II	**Introduction to JavaScript** - Syntax, Document object, Variables, declaration & operators, Data types, Conditional statements & Loops, Objects & Arrays, Date Time, Functions, Debugging.	**CO1,CO2, CO4**
III	**Introduction to ReactJS** - Installation/Configuring react environments, JSX, Components & Props, State & lifecycle, Virtual DOM, Routing, Data Management - Rest API, Local Storage,	**CO1, CO2, CO4**

	Debugging	
IV	**Introduction to backend** - Overview of (nodejs or java), Request Types -POST, PUT, PATCH,DELETE, GET, Response Types - json, xml, string, etc, Develop endpoints/ REST API, Cookies, Authentication & Authorization (using in memory data structures), Database connectivity (One with SQL and one with NoSql), Authentication & Authorization (using stored data login data in DB, Auth0), CRUD Operations, Protect API/App from unauthorized access., Add a cache for frequently used data, Logging, Debugging	**CO1, CO3, CO4**
V	**VSC, Full Stack Project & deploying the application**- Version Control System - Git & Github, Create an simple project, Login page, Automatic redirect when user login time expired, Packaging the application.	**CO1, CO2, CO3, CO4**

Learning Resources
Text Books
1. Web Technologies, Black Book, Kogent Learning Solutions Inc, Dreamtech Press. 2. Learning React Functional Web Development with React and Redux by Alex Banks and Eve Porcello, 2017, O'Reilly books 3. Version Control with Git, Jon Loeliger, Matthew McCullough, 2nd Edition, 2012,O'Reilly Media
References
1. Fullstack React: The Complete Guide to ReactJS and Friends by Anthony Accomazzo, Fullstack, 2017, IO publisher. 2. Modern Full-Stack Development:Using TypeScript, React, Node.js, Webpack, and Docker, by Rank Zammetti, Apress publisher, 1st edition (1 January 2020)
e-Resources and other Digital Material
1. https://www.freecodecamp.org/news/fullstack-react-blog-app-with-express-and-psql/ 2. https://fullstackopen.com/en/ 3. https://aws.amazon.com/getting-started/hands-on/build-react-app-amplify-graphql/ 4. https://www.fullstacktutorials.com/tutorials/reactjs/reactjs-tutorial.html

ADVANCED MOBLIE APPICATION DEVELOPMENT

Course Code	20CS6721	**Year**	IV	**Semester**	I
Course Category	Honors	**Branch**	**CSE**	**Course Type**	Theory
Credits	4	**L-T-P**	4-0-0	**Prerequisites**	Programming with Java
Continuous Internal Evaluation:	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand fundamental concepts of mobile application development	**L2**
CO2	Apply the concepts of user interface to develop front end application	**L3**
CO3	Apply the concepts of database connectivity and Testing Tools to implement back end application.	**L3**
CO4	Apply testing strategies,tools and framework to identify and resolve issues in applications and publish APP on google play store	**L3**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO1 2**	**PSO 1**	**PSO 2**
CO1													√	
CO2						√	√						√	
CO3						√	√		√	√			√	
CO4						√	√						√	

Syllabus

Unit No.	**Contents**	**Mapped CO**
I	An Overview of the Android Platform: A Brief History of Mobile Software Development, The Android Platform, Building Your First Android Application-Creating and Configuring a New Android Project, Core Files and Directories of the Android Application, Creating an AVD for Your Project, Android Application Basics-Understanding the Anatomy of an Android Application -Mastering Important Android Terminology, Performing Application Tasks with Activities-The Lifecycle of an Android Activity, Managing Activity Transitions with Intents, Defining Your Application Using the Android Manifest File - Configuring Android Applications Using the Android Manifest File.	**CO1, CO2**

II	Managing Application Resources-What Are Resources?, Working with Different Types of Resources, Working with Layouts, Exploring User Interface Building Blocks-Introducing Android Views and Layouts, Displaying Text to Users with TextView, Retrieving Data from Users with Text Fields, Giving Users Choices Using Spinner Controls, Allowing Simple User Selections with Buttons and Switches, Retrieving Dates, Times, and Numbers from Users with Pickers, Using Indicators to Display Progress and Activity to Users, Adjusting Progress with Seek Bars	**CO1, CO2, CO4**
III	Designing with Layouts-Creating User Interfaces in Android, Organizing Your User Interface, Using Built-in Layout Classes, Partitioning the User Interface with Fragments-Understanding Fragments, Using the Android Support Package, Displaying Dialogs-Choosing Your Dialog Implementation, Exploring the Different Types of Dialogs, Working with Dialogs and Dialog Fragments	**CO1, CO2, CO4**
IV	Android Application Design Essentials: Using Android Preferences-Working with Application Preferences, Finding Preferences Data on the Android File System, Creating Manageable User Preferences, Working with Files and Directories-Working with Application Data on a Device, Leveraging Content Providers-Exploring Android's Content Providers.	**CO1, CO3, CO4**
V	Testing Android Applications-Best Practices in Testing Mobile Applications, Android Application Testing Essentials, Publishing Your Android Application-Choosing the Right Distribution Model, Packaging Your Application for Publication, Publishing to Google Play	**CO1, CO3, CO4**

Learning Resources
Text Book
1. Advanced Android Application Development by Joseph Annuzzi Jr., Lauren Darcey, and Shane Conde, 4th edition , 2014, Addison-Wesley 2. https://google-developer-training.github.io/android-developer-advanced-course-concepts/android-developer-advanced-course-concepts.pdf (https://google-developer-training.github.io/android-developer-advanced-course-concepts/ Last updated 2022-02-15 UTC.)
References
1. Android Database Best Practices (Android Deep Dive) by Adam Stroud,2016, Addison Wesley 2. Android Programming: Pushing the Limits, by Erik Hellman, 1st edition, 2013, Wiley
e-Resources and other Digital Material
1. https://google-developer-training.github.io/android-developer-advanced-course-concepts/android-developer-advanced-course-concepts.pdf

Network Programming

Course Code	20CS6721	**Year**	IV	**Semester**	I
Course Category	Honors	**Branch**	CSE	**Course Type**	Theory
Credits	4	**L-T-P**	4-0-0	**Prerequisites**	Computer Networks, Operating System Linux shell Programming, C Programming
Continuous Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand inter process and inter-system communication	**L2**
CO2	Apply socket programming to implement client-server applications using TCP, UDP Sockets	**L3**
CO3	Apply the concept of Socket Programming to Broadcasting and Multicasting	**L3**
CO4	Analyze the network socket programs to build network applications	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√													
CO2	√				√								√	
CO3	√												√	
CO4		√							√	√			√	√

Syllabus		Mapped CO
Unit No.	**Contents**	
I	**Introduction to Network Programming:** OSI model, Unix standards, TCP and UDP & TCP connection establishment and Format, Buffer sizes and limitation, standard internet services, Protocol usage by common internet application. **Sockets:** Address structures, value – result arguments, Byte ordering and manipulation function and related functions Elementary TCP sockets – Socket, connect, bind, listen, accept, fork and exec function, concurrent servers. Close function and related function.	**CO1, CO2, CO4**
II	**TCP client server :** Introduction, TCP Echo server functions, Normal startup, terminate and signal handling server process termination, Crashing and Rebooting of server host shutdown of server host. **Elementary UDP sockets:** Introduction UDP Echo server function, lost datagram, summary of UDP example, Lack of flow control with UDP, determining outgoing interface with UDP. **I/O Multiplexing:** I/O Models, select function, Batch input, shutdown function, poll function, TCP Echo server.	**CO1, CO2**
III	**Socket options:** getsockopt and setsockopt functions. Socket states, Generic socket option IPV6 socket option ICMPV6 socket option IPV6 socket option and TCP socket options. **Advanced I/O Functions-** Introduction, Socket Timeouts, recv and send Functions,readv and writev Functions, recvmsg and sendmsg Functions, Ancillary Data, How Much Data Is Queued?, Sockets and Standard I/O, T/TCP: TCP for Transactions.	**CO1, CO4**
IV	**Elementary name and Address conversions:** DNS, gethost by Name function, Resolver option, Function and IPV6 support, uname function, other networking information. **Daemon Processes and inetd Superserver** – Introduction, syslogd Daemon, syslog Function, daemon_init Function, inetd Daemon, daemon_inetd Function. **Broadcasting-** Introduction, Broadcast Addresses, Unicast versus Broadcast, dg_cli Function Using Broadcasting, Race Conditions.	**CO1, CO3,CO4**
V	**Multicasting-** Introduction, Multicast Addresses, Multicasting versus Broadcasting on A LAN, Multicasting on a WAN, Multicast Socket Options, mcast join and Related Functions, dg_cli Function Using Multicasting, Receiving	**CO1, CO2, CO3,CO4**

	MBone Session Announcements, Sending and Receiving, SNTP: Simple Network Time Protocol, SNTP	

Learning Resources
Text Books
1. UNIX Network Programming, W. Richard Stevens, Bill Fenner, Andrew M. Rudoff, Third Edition, Pearson Education,2015 2. UNIX Network Programming, W. Richard Stevens. Second Edition Pearson,2015
References
1. UNIX Systems Programming using C++, T Chan, First Edition,Pearson,2015 2. UNIX for Programmers and Users, Graham Glass, King abls, Third Edition Pearson Education, 2003 3. Advanced UNIX Programming, M. J. ROCHKIND, Second Edition Pearson Education,2004.
e-Resources & other digital material
1. http://wps.aw.com/aw_kurose_network_2 2. http://www.kohala.com/start/unpv12e.html 3. http://www.netbook.cs.purdue.edu 4. http://www.cs.arizona.edu/llp/book/book.html

CLOUD COMPUTING

Course Code	20CS5701	**Year**	IV	**Semester**	I
Course Category	Minor	**Branch**		**Course Type**	Theory
Credits	4	**L-T-P**	4-0-0	**Prerequisites**	Computer Networks, Operating Systems
Continuous Internal Evaluation :	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Understand the basic concepts of virtualization and Cloud Computing.	**L2**
CO2	Apply cloud computing framework to build and deploy customized applications	**L3**
CO3	Analyse the given application and choose suitable platform for deploying cloud.	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	√													
CO2	√								√	√			√	
CO3		√							√	√			√	

Syllabus		Mapped CO
Unit No.	Contents	
I	Introduction to Cloud: Cloud Computing at a Glance, The Vision of Cloud Computing, Defining a Cloud, A Closer Look, Cloud Computing Reference Model. Characteristics and Benefits, Challenges Ahead, Historical Developments. Virtualization: Introduction, Characteristics of Virtualized Environment, Taxonomy of Virtualization Techniques, Virtualization and Cloud computing, Pros and Cons of Virtualization, Technology Examples- VMware and Microsoft Hyper-V.	CO1
II	Cloud Computing Architecture : Introduction, Cloud Reference Model, Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economics of the Cloud, Open Challenges, Cloud Interoperability and Standards, Scalability and Fault Tolerance.	CO1,CO2, CO3
III	Aneka: Cloud Application Platform Framework Overview, Anatomy of the Aneka Container, From the Ground Up: Platform Abstraction Layer, Fabric Services, Foundation Services, Application Services, Building Aneka Clouds, Infrastructure Organization, Logical Organization, Private Cloud Deployment Mode, Public Cloud Deployment Mode, Hybrid Cloud Deployment Mode, Cloud Programming and Management, Aneka SDK, Management Tools.	CO1,CO2, CO3
IV	Cloud Applications: Scientific Applications – Health care, Geoscience and Biology. Business and Consumer Applications- CRM and ERP, Social Networking, Media Applications and Multiplayer Online Gaming.	CO1,CO3
V	Cloud Platforms in Industry: Amazon Web Services- Compute Services, Storage Services, Communication Services and Additional Services. Google App Engine-Architecture and Core Concepts, Application Life-Cycle, cost model. Microsoft Azure- Azure Core Concepts, SQL Azure.	CO1,CO3

Learning Resources
Text Books
1. Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi, 2013, TMH.
References
1. Cloud Computing Principles and Paradigms, Rajkumar Buyya , James Broberg, Andrzej Goscinski, Wiley Publishing. 2. Cloud Application Architectures, George Reese , First Edition, O"Reilly, Media 2009. 3. Cloud Computing – web based Applications that change the way you work and collaborate Online, Micheal Miller,.Pearson Education.
e-Resources and other Digital Material
1. http://www.slideshare.net/himanshuawasthi2109/cloud-computing-ppt-16240131 2. https://nptel.ac.in/courses/106105167

3. https://www.youtube.com/watch?v=r8Lu_BjxlZc
4. http://video.mit.edu/watch/mitef-nyc-cloud-computing-8347/

Project Work, Seminar and Internship in Industry

Course Code	20CS3861	**Year**	IV	**Semester**	II
Course Category	-	**Branch**	CSE	**Course Type**	Project
Credits	8	**L-T-P**	0-0-0	**Prerequisites**	-
Continuous Evaluation :	60	**Semester End Evaluation:**	140	**Total Marks:**	200

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Apply the knowledge of mathematics, computer science fundamentals, and computer science specializations to solving engineering problems.	**L3**
CO2	Analyze the problem solution, requirements, feasibility study and scope with appropriate planning in compiling the project's work using a literature review.	**L4**
CO3	Apply the engineering knowledge in project design and use methods to carry out the project work by justifying ethical principles.	**L3**
CO4	Create an economic ecosystem using modern tools to meet societal needs and examine the results obtained to derive conclusions.	**L6**
CO5	Analyze the performance of the project task as an individual and team member based on their effective communication, presentation, and report to manage the task in time.	**L5**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:Substantial, 2: Moderate, 1:Slight)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO1 2**	**PSO 1**	**PSO 2**
CO1	√											√	√	√
CO2		√										√		
CO3			√	√				√					√	√
CO4					√	√	√							
CO5									√	√	√			

ANNEXURE

COMMUNITY SERVICE PROJECT

Experiential learning through community engagement as per the decision of the concerned department BoS.

Introduction

- Community Service Project is an experiential learning strategy that integrates meaningful community service with instruction, participation, learning and community development
- Community Service Project involves students in community development and service activities and applies the experience to personal and academic development.
- Community Service Project is meant to link the community with the college for mutual benefit. The community will be benefited with the focused contribution of the college students for the village/ local development. The college finds an opportunity to develop social sensibility and responsibility among students and also emerge as a socially responsible institution.

Objective

Community Service Project should be an integral part of the curriculum, as an alternative to the 2 months of Summer Internships / Apprenticeships / On the Job Training, whenever there is an exigency when students cannot pursue their summer internships. The specific objectives are;

- To sensitize the students to the living conditions of the people who are around them,
- To help students to realize the stark realities of the society.
- To bring about an attitudinal change in the students and help them to develop societal consciousness, sensibility, responsibility and accountability
- To make students aware of their inner strength and help them to find new /out of box solutions to the social problems.
- To make students socially responsible citizens who are sensitive to the needs of the disadvantaged sections.
- To help students to initiate developmental activities in the community in coordination with public and government authorities.
- To develop a holistic life perspective among the students by making them study culture, traditions, habits, lifestyles, resource utilization, wastages and its management, social problems, public administration system and the roles and responsibilities of different persons across different social systems.

Implementation of Community Service Project

- Every student should put in a minimum of **180 hours** for the Community Service Project during the summer vacation.
- Each class/section should be assigned with a mentor.
- Specific Departments could concentrate on their major areas of concern. For example, Dept. of Computer Science can take up activities related to Computer Literacy to different sections of people like - youth, women, house-wives, etc
- A log book has to be maintained by each of the student, where the activities undertaken/involved to be recorded.
- The log book has to be countersigned by the concerned mentor/faculty incharge.

- Evaluation to be done based on the active participation of the student and grade could be awarded by the mentor/faculty member.
- The final evaluation to be reflected in the grade memo of the student.
- The Community Service Project should be different from the regular programmes of NSS/NCC/Green Corps/Red Ribbon Club, etc.
- Minor project report should be submitted by each student. An internal Viva shall also be conducted by a committee constituted by the principal of the college.
- Award of marks shall be made as per the guidelines of Internship/apprentice/ on the job training

Procedure

- A group of students or even a single student could be assigned for a particular habitation or village or municipal ward, as far as possible, in the near vicinity of their place of stay, so as to enable them to commute from their residence and return back by evening or so.
- The Community Service Project is a twofold one–
    - First, the student/s could conduct a survey of the habitation, if necessary, in terms of their own domain or subject area. Or it can even be a general survey, incorporating all the different areas. A common survey format could be designed. This should not be viewed as a duplication of work by the Village or Ward volunteers; rather, it could be another primary source of data.
    - Secondly, the student/s could take up a social activity, concerning their domain or subject area. The different areas, could be like–
        - Agriculture
        - Health
        - Marketing and Cooperation
        - Animal Husbandry
        - Horticulture
        - Fisheries
        - Sericulture
        - Revenue and Survey
        - Natural Disaster Management
        - Irrigation
        - Law &Order
        - Excise and Prohibition
        - Mines and Geology
        - Energy
        - Internet
        - Free Electricity
        - Drinking Water

EXPECTED OUTCOMES

BENEFITS OF COMMUNITY SERVICE PROJECT TO STUDENTS

Learning Outcomes

- Positive impact on students' academic learning
- Improves students' ability to apply what they have learned in —the real world‖
- Positive impact on academic outcomes such as demonstrated complexity of understanding, problem analysis, problem-solving, critical thinking, and cognitive development
- Improved ability to understand complexity and ambiguity

Personal Outcomes

- Greater sense of personal efficacy, personal identity, spiritual growth, and moral development
- Greater interpersonal development, particularly the ability to work well with others, and build leadership and communication skills

Social Outcomes

- Reduced stereotypes and greater inter-cultural understanding
- Improved social responsibility and citizenship skills
- Greater involvement in community service after graduation

Career Development

- Connections with professionals and community members for learning and career opportunities
- Greater academic learning, leadership skills, and personal efficacy can lead to greater opportunity

Relationship with the Institution

- Stronger relationships with faculty
- Greater satisfaction with college
- Improved graduation rates

BENEFITS OF COMMUNITY SERVICE PROJECT TO FACULTY MEMBERS

- Satisfaction with the quality of student learning
- New avenues for research and publication via new relationships between faculty and community
- Providing networking opportunities with engaged faculty in other disciplines or institutions
- A stronger commitment to one's research

BENEFITS OF COMMUNITY SERVICE PROJECT TO COLLEGES AND UNIVERSITIES

- Improved institutional commitment
- Improved student retention
- Enhanced community relations

BENEFITS OF COMMUNITY SERVICE PROJECT TO COMMUNITY

- Satisfaction with student participation
- Valuable human resources needed to achieve community goals
- New energy, enthusiasm and perspectives applied to community work
- Enhanced community-university relations.

SUGGESTIVE LIST OF PROGRAMMES UNDER COMMUNITY SERVICE PROJECT

The following is the recommended list of projects for engineering students. The lists are not exhaustive and open for additions, deletions and modifications. Colleges are expected to focus on specific local issues for this kind of projects. The students are expected to carry out these projects with involvement, commitment, responsibility and accountability. The mentors of a group of students should take the responsibility of motivating, facilitating, and guiding the students. They have to interact with local leadership and people and appraise the objectives and benefits of this kind of projects. The project reports shall be placed in the college website for reference. Systematic, Factual, methodical and honest reporting shall be ensured.

For Engineering Students

1. Water facilities and drinking water availability
2. Health and hygiene
3. Stress levels and coping mechanisms
4. Health intervention programmes
5. Horticulture
6. Herbal plants
7. Botanical survey
8. Zoological survey
9. Marine products
10. Aquaculture
11. Inland fisheries
12. Animals and species
13. Nutrition
14. Traditional health care methods
15. Food habits
16. Air pollution
17. Water pollution
18. Plantation
19. Soil protection
20. Renewable energy
21. Plant diseases
22. Yoga awareness and practice
23. Health care awareness programmes and their impact
24. Use of chemicals on fruits and vegetables
25. Organic farming
26. Corporation
27. Floury culture
28. Access to safe drinking water
29. Geographical survey
30. Geological survey
31. Sericulture
32. Study of species
33. Food adulteration

34. Incidence of Diabetes and other chronic diseases
35. Human genetics
36. Blood groups and blood levels
37. Internet Usage in Villages
38. Android Phone usage by different people
39. Utilisation of free electricity to farmers and related issues
40. Gender ration in schooling level-observation.

Complementing the community service project the students may be involved to take up some awareness campaigns on social issues/special groups. The suggested list of programmes are;

Programmes for School Children

1. Reading Skill Programme (Reading Competition)
2. Preparation of Study Materials for the next class.
3. Personality / Leadership Development
4. Career Guidance for X class students
5. Screening Documentary and other educational films
6. Awareness Programme on Good Touch and Bad Touch (Sexual abuse)
7. Awareness Programme on Socially relevant themes.

Programmes for Women Empowerment

1. Government Guidelines and Policy Guidelines
2. Womens‘ Rights
3. Domestic Violence
4. Prevention and Control of Cancer
5. Promotion of Social Entrepreneurship

General Camps

1. General Medical camps
2. Eye Camps
3. Dental Camps
4. Importance of protected drinking water
5. ODF awareness camp
6. Swatch Bharath
7. AIDS awareness camp
8. Anti Plastic Awareness
9. Programmes on Environment
10. Health and Hygiene
11. Hand wash programmes
12. Commemoration and Celebration of important days

Programmes for Youth Empowerment

1. Leadership
2. Anti-alcoholism and Drug addiction
3. Anti-tobacco
4. Awareness on Competitive Examinations
5. Personality Development

Common Programmes

1. Awareness on RTI
2. Health intervention programmes
3. Yoga
4. Tree plantation
5. Programmes in consonance with the Govt. Departments like–
    - i. Agriculture
    - ii. Health
    - iii. Marketing and Cooperation
    - iv. Animal Husbandry
    - v. Horticulture
    - vi. Fisheries
    - vii. Sericulture
    - viii. Revenue and Survey
    - ix. Natural Disaster Management
    - x. Irrigation
    - xi. Law &Order
    - xii. Excise and Prohibition
    - xiii. Mines and Geology
    - xiv. Energy

Role of Students:

- Students may not have the expertise to conduct all the programmes on their own. The students then can play a facilitator role.
- For conducting special camps like Health related, they will be coordinating with the Governmental agencies.
- As and when required the College faculty themselves act as Resource Persons.
- Students can work in close association with Non-Governmental Organizations like Lions Club, Rotary Club, etc or with any NGO actively working in that habitation.
- And also with the Governmental Departments. If the programme is rolled out, the District Administration could be roped in for the successful deployment of the programme.
- An in-house training and induction programme could be arranged for the faculty and participating students, to expose them to the methodology of Service Learning.

Timeline for the Community Service Project Activity

Duration: 8 weeks

1. **Preliminary Survey (One Week)**
    - A preliminary survey including the socio-economic conditions of the allotted habitation to be conducted.
    - Asurveyformbasedonthetypeofhabitationtobepreparedbeforevisitingthehabitation with the help of social sciences faculty. (However, a template could be designed for different habitations, rural/urban.
    - The Governmental agencies, like revenue administration, corporation and municipal authorities and village secretariats could be aligned for the survey.

2. **Community Awareness Campaigns (Two Weeks)**
    - Based on the survey and the specific requirements of the habitation, different awareness campaigns and programmes to be conducted, spread over two weeks of time. The list of activities suggested could be taken into consideration.

3. **Community Immersion Programme (Four Weeks)**

    Along with the Community Awareness Programmes, the student batch can also work with any one of the below listed governmental agencies and work in tandem with them. This community involvement programme will involve the students in exposing themselves to the experiential learning about the community and its dynamics. Programmes could be in consonance with the Govt. Departments.

4. **Community Exit Report (One Week)**

    During the last week of the Community Service Project, a detailed report of the outcome of the 8 weeks work to be drafted and a copy shall be submitted to the local administration. This report will be a basis for the next batch of students visiting that particular habitation. The same report submitted to the teacher-mentor will be evaluated by the mentor and suitable marks are awarded for onward submission to the University.

    Throughout the Community Service Project, a daily log-book need to be maintained by the students batch, which should be countersigned by the governmental agency representative and the teacher-mentor, who is required to periodically visit the students and guide them.