MATURI VENKATA SUBBA RAO ENGINEERING COLLEGE
(An Autonomous Institution)

BACHELOR OF ENGINEERING

ACADEMIC REGULATIONS , SCHEME OF INSTRUCTION & SYLLABI (R-21)

COMPUTER SCIENCE AND ENGINEERING (IoT-CS-BcT)

(I to VIII Semesters)
(2022-26)

ACADEMIC YEAR 2024-25

(Sponsored by Matrusri Education Society, Estd.1980)

ACADEMIC RULES AND REGULATIONS
for
Four Year
BACHELOR OF ENGINEERING
DEGREE PROGRAMME

Maturi Venkata Subba Rao (MVSR) Engineering College

(An Autonomous Institution)

(Sponsored by Matrusri Education Society, Estd.1980)

Approved by AICTE, Affiliated to Osmania University
Accredited by NAAC and ISO 9001:2015 Certified Inst.
NBA Accreditation: CIVIL, CSE, ECE, EEE, IT and MECH.

website: www.mvsrec.edu.in

Counseling Code: TSEAMCET/TSECET/TSICET: MVSR

PGECET: MVSR1

(For the batches admitted in 2022-23, 2023-24(R-21))

B.E. PROGRAMME
(Full-time)

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of
ACADEMIC RULES & REGULATIONS

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ACADEMIC RULES AND REGULATIONS For

Four Year Degree Programme in Engineering of

Maturi Venkata Subba Rao (MVSR) Engineering College

(For the batch admitted in2022-23, 2023-24 (R-21))

PREAMBLE: All the Rules and Regulations, here in after specified shall be read as a whole for the purpose of interpretation. Any reference to college in these Rules and Regulations stands for Maturi Venkata Subba Rao (MVSR) Engineering College. In case of arising a doubt, the interpretation of the Academic Council, the Statutory Body constituted as per UGC regulations of the college is final. The Academic council has the powers to make amendments to these regulations whenever necessary and shall be approved byGoverning Body (GB).

ABBREVIATIONS:

AC	Academic Council
AICTE	All India Council for Technical Education
BE	Bachelor of Engineering
BoS	Board of Studies
GB	Governing Body
C	Credits
CGPA	Cumulative Grade Point Average
CIE	Continuous Internal Evaluation
CP	Credit Point
D	Drawing
GO	Government Order
GP	Grade Point
L	Lecture
MOOC	Massive Open Online Course
MVSREC	Maturi Venkata Subba Rao Engineering College
NPTEL	National Programme on Technology Enhanced Learning
P	Practical
SEE	Semester End Examination
SGPA	Semester Grade Point Average
SWAYAM	Study Webs of Active Learning for Young and Aspiring Minds
T	Tutorial
UG	Under Graduate
UGC	University Grants Commission

NOMENCLATURE:

S. No.	Keywords	Definition
1	**Governing Body**	Highest administrative body of the Institute. GB is an authority as per the AICTE/ UGC regulations and responsible to perform functions as may be necessary and deemed fit for the proper development of the institution.
2	**Academic Council**	Highest academic body of the Institute and is responsible for the maintenance of standards of instruction, education and examination within the Institute. Academic Council is an authority as per the AICTE / UGC regulations and has the right to take decisions on all academic matters including academic research.
3	**Academic Year**	A period that is necessary to complete courses of study. It consists of two consecutive (one odd +one even) semesters.
4	**Autonomous Institute**	An Institute designated as 'Autonomous' by University Grants Commission (UGC), New Delhi in concurrence with the affiliating University i.e., Osmania University, Hyderabad and Telangana State Government.
5	**Board of Studies**	An authority, as defined in UGC regulations, constituted by the Principal for each of the department separately. The board is responsible for curriculum design and update in respect of all the programmes offered by a department.
6	**Course**	Usually referred to, as „papers" is a component of a programme. All courses need not carry the same weightage. The learning objectives and learning outcomes are defined for each course. A course is designed to comprise lectures/ tutorials/ laboratory work/ field work/ outreach activities/ project work/ vocational training/viva/ seminars/ term papers/ assignments/ presentations/self-study etc. or a combination of some of these.
7	**Course Evaluation**	Continuous Internal Evaluation (CIE) in the Semester & Semester End Examination (SEE) constitutes the main assessment prescribed for each course.
8	**Continuous Internal Evaluation (CIE)**	To be normally conducted by the course instructor which includes class tests, problem solving exercises, group discussions, assignments, quizzes, mini-projects & seminars conducted anytime throughout the semester.
9	**Credit**	A unit by which the course work is measured. One credit is equivalent to one lecture hour of teaching (lecture or tutorial) or two hours ofpractical / field work per week.
10	**Grade Point**	It is a numerical weight allotted to each letter grade on a 10-point scale. A+ =10, A = 9, B = 8, C = 7, D = 6, E = 5 and F = 0.
11	**Credit Point**	A product ofgrade point and number ofcredits for a course.

12	**Cumulative Grade Point Average (CGPA)**	It is a measure of overall cumulative performance, of a student in all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters of the program. It is expressed upto two decimal places.
13	**Programme**	A programme or specialization of a degree programme like Civil Engineering, Mechanical Engineering etc.
14	**Curriculum**	Curriculum incorporates all the courses that are offered in a specific programme. It also indicates the planned interaction of students with instructional content, materials, and resources.
15	**Degree**	A student who fulfills all the programme requirements is eligible to receive a degree.
16	**Grading**	To be normally done using Letter Grades as qualitative measure of achievement in each Course like: A+ (Outstanding), A (Excellent), B (Very Good), C (Good), D (Average), E (Pass), F (Fail) based on the marks (%) scored in (CIE+SEE) of the course and conversion to grade done by relative/absolute grading.
17	**Mandatory Courses**	Compulsory non-credit courses that a student need to study as prescribed in the programme.
18	**Massive Open Online Courses (MOOC)**	Open access online courses aimed at providing ways to learn new skills.
19	**Revision of Regulations, Curriculum and Syllabi**	The institution, from time to time may revise, amend or change the regulations, scheme of examinations, curriculum and syllabi with the approval of the academic council.
20	**Semester End Examination (SEE)**	To be normally conducted at the institutional level which will cover the entire course syllabi. The SEE questions are to be set from each unit. The questions are to be based on Blooms Taxonomy
21	**Semester**	Each year of study is divided into two semesters. Semester shall consist of 16 weeks of academic work excluding Semester End Examination and Evaluation.
22	**Semester Grade Point Average (SGPA)**	It is a measure of performance of work done in a semester. It is ratio of total credit points secured by a student in various theory and lab courses offered in each semester and the total course credits taken during that semester. It shall be expressed upto two decimal places.

I. ADMISSION PROCEDURE

1. A candidate for admission to the Four Year Degree Programme in Engineering must have passed the Intermediate Examination of the Board of Intermediate Education, Government of Telangana with Mathematics, Physics and Chemistry as optional courses, or any other examination recognized by the Government of Telangana as equivalent there to.

2. A candidate will be admitted strictly in accordance with the guidelines issued by State Government of Telangana from time to time.

II. DURATION AND PROGRAMMES OF STUDY

The duration of the programme is eight semesters (four years) such as I, II, III, IV, V, VI, VII and VIII. Each academic year shall comprise of two semesters.

Instruction per semester	---	16 weeks
Preparation holidays (includes practical exams)	---	02 weeks

No admission/ readmission/ promotion are entertained after four weeks of the commencement of instruction ofsemester in I, II, III and IV years.

In case there are any court cases consequent to which the authorities are compelled to admit any candidate after the announced last date of admissions, the admission (seat) of such a student would be reserved for the subsequent year on a supernumerarybasis.

No refund of Tuition fee will be made after the commencement of instruction for students who wish to cancel their admission.

1. The following programmes ofstudy are offered by the college.

S. No	Programme
i).	Automobile Engineering
ii).	Civil Engineering
iii).	Computer Science and Engineering
iv).	Computer Science and Engineering (Data Science)
v).	Computer Science and Engineering (AI &ML)
vi).	Computer Science and Engineering (IOT-CS-BCT)
vii).	Computer Science and Information Technology
viii).	Electrical and Electronics Engineering
ix).	Electronics and Communication Engineering
x).	Information Technology
xi).	Mechanical Engineering

The schedule of study of all programmes is regulated by the Academic council of Maturi Venkata Subba Rao (MVSR) Engineering College.

2. Candidate who fails to fulfill all the requirements for the award of the degree as specified here in after within (N+2) academic years from the time of admission, *as per the UGC Guidelines on determination of uniform span period (UGC Letter No. F-12-1/2015 (CPP-II) dated and 15.10.2015 and Osmania University letter No.336/M/Acad.I/2016 dated 21.03.2016)*, will forfeit his/her seat in the programme and his/her admission will stand cancelled, where "N" is the number of years of programme of study. For four year regular B.E. degree programme maximum duration ofstudy is (N+ 2) =4 +2 = 6 years.

   Candidate admitted to the second year under lateral entry scheme shall fulfill all the requirements for the award of the degree as specified here in after within (N+2=3+2=5) five academic years from the time of admission failing which he/she will forfeit his/her seat and his/her admission will stand cancelled.

III. RULES AND REGULATIONS OF ATTENDANCE

1. Candidates admitted to a particular programme of study are required to pursue **Regular programme of study** before they are permitted to appear for the Semester End Examination.
2. **A regular programme of study** means putting in attendance of not less than 75% in each semester.
3. In special cases and for sufficient cause shown, the Academic Council (AC) may condone the deficiency in attendance to the extent of 10% on medical grounds subject to the submission of medical certificate (signed by Competent Authority) along with the payment of condonation fee too.. However, in respect of women candidates who seek condonation of attendance due to pregnancy, the Academic Council (AC) on the specific recommendations may condone the deficiency in attendance to the extent of 15% (as against 10% condonation for others) on medical grounds (Valid Medical certificate) subject to submission of medical certificate to this effect. Such condonation is permitted only once during the programme of study. Medical certificate along with the fitness is to be submitted within a week days on reporting to the class work.

   * **Shortage of attendance below 65 % shall in no case be condoned.**
4. The fee for condonation of attendance on medical grounds shall be Rs. 2000/- (Rupees Two Thousand only) payable through DD/ Banker Cheque drawn in favour of Principal, Maturi Venkata Subba Rao (MVSR) Engineering College.
5. Attendance of N.C.C / N.S.S Camps or Inter collegiate or Inter-University or Inter State or International matches or debates or Educational Excursions or such other Inter University activities as approved by the authorities involving journeys outside the city in which the college is situated will not be counted as absence.

   i. Such absence shall not exceed four weeks per semester of the total period of instructions.

   ii. Such leave should be availed with prior permission from the Principal and not be availed more than twice during the programme of study.

   iii Without anyprior permission, such leave shall be treated as absence.

   iv While calculating the attendance, the number of classes not attended in each subject shallbe added to the numerator.

6. The attendance shall be calculated on the aggregate of courses from the date of commencement of classes/ date of readmission in case of detained candidates as per the almanac.
7. In case of candidates who fail to put in the required attendance in a programme of study, he/she shall be detained in the same semester and will not be permitted to appear for the Semester End Examination. Such candidates shall have to seek re admission into the same semester during the subsequent year in order to appear for the examination after fulfilling the attendance requirements and on payment ofrequisite tuition fee.

IV. SCHEME OF INSTRUCTIONS AND EXAMINATION

1. Instructions in various courses in each semester of all four years shall be provided by the college as per the scheme of instruction and syllabi prescribed. All students have to register for the courses offered in the Semester before starting ofthat particular semester.

2. The total number ofcredits for all eight semesters is 160 as per AICTE Model Curriculum

3. The distribution of marks/grade* based on Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE) shall be as follows:

Subject	Continuous Internal Evaluation (CIE)	Semester End Examination (SEE)
Each theory subject	**30 ****	**70 ******
Each practical or drawing Subject for which less than 6 periods / week are provided in the scheme of instruction	**25 ****	**50**
Each practical or drawing Subject for which 6 or mor Periods/week are provided in the scheme o instructio	**50 *****	**100**
Project Work – I	**50 #**	**---**
Project Work – II	**50 #**	**100 ##**

Total marks = CIE + SEE

***** Grades are allotted based on the marks secured in CIE and SEE as per the following criteria.

Academic Performance	Grade		Grade points
	Letter	Description	
90% ≤ Marks ≤ 100%	**A +**	Outstanding	10
80% ≤ Marks < 90%	**A**	Excellent	9
70% ≤ Marks < 80%	**B**	Very Good	8
60% ≤ Marks < 70%	**C**	Good	7
50% ≤ Marks < 60%	**D**	Average	6
40% ≤ Marks < 50%	**E**	Pass	5
0% ≤ Marks < 40%	**F**	Fail	0
	AB	Absent	

** Out of 30 CIE marks for theory, 10 marks are allotted for Assignments/Tutorials/Quizzes etc. (At least two assignments and two quizzes are to be conducted) in the course. The rest of the 20 marks are allotted to internal tests. Two internal tests will be conducted in each semester. Each test will carry 20 marks, out of which 6 marks for PART-A (compulsory), consisting of three short answer questions and from Part- B two questions consisting of subjective questions are to be attempted from the remaining three questions and each question carries 7 marks. Average of two tests plus marks obtained in assignments/tutorials/quizzes etc. will be taken as CIE marks.

*** Out of 25/50 CIE marks for Practical/drawing, 10/ 20 are allotted for viva- voce exam / Quiz test, 15/30 marks for laboratory record/drawing sheets and observations.

**** The SEE question paper consists of seven questions and each question carries 14 marks. The first question is compulsory and covers the entire syllabus as part A. Student has to answer four questions from the remaining six questions that cover the entire syllabus as part B.

The CIE evaluation of BE Project (Project Work - I & II) consists of a maximum of 50 marks which will be distributed as per the guidelines given below:

i. **30 Marks** are allocated for quality of the project work covering
   1. Literature review
   2. Innovation/ Originality
   3. Methodology and
   4. Relevance / Practical application which will be awarded by the supervisor.

ii. **20 Marks** are allocated to candidate's performance in terms of viva-voce examination and overall subject knowledge. Marks will be awarded by the committee constituted by the HoD.

The evaluation of BE Project (Project Work - II) for Semester End Examination consists of a maximum of 100 marks which will be distributed as per the guidelines given below:

iii. **50 Marks** are allocated for quality of the project work covering
   a. Literature review
   b. Innovation / Originality
   c. Methodology and
   d. Relevance/ Practical application, which will be awarded jointly by the internal and external examiners.

iv. **50 Marks** are provided for candidate's presentation and performance in terms of viva-voce examination and overall subject knowledge. Out of 50 Marks 30 marks will be awarded by the internal examiner and 20 marks by the external examiner concerned.

Note:

i. A course that has CIE but no SEE as per scheme is treated as Pass/ Fail for which pass marks are 40% of CIE marks.

ii. Mandatory courses shall not carry any credits but, securing **40% of total marks**, shall be **necessary requirement** for the student to qualify for the **award of Degree.**

I. The details of instruction period, examination schedule, vacation etc. shall be notified by the Principal, Maturi Venkata Subba Rao Engineering College.

II. The medium of instruction and examination shall be English.

III. At the end of each semester, SEE shall be held as prescribed in the respective Schemes of Examination. The examinations pertaining to the semester just ended, will be called, regular examinations and the examinations pertaining to the other semesters will be called supplementary examinations. To enable the B.E. Final Year students to complete the program requirements in time, there shall be a Make-up / Supplementary Exam for VIII semester only, which will be scheduled within one month of publication of results of VIII semester regular examinations.

IV. The examinations prescribed may be conducted by means of written papers, practical and viva-voce, inspection of certified CIE work in Drawing and Laboratories and Workshop, or by means of any combination of these methods as may be deemed necessary. Candidates will be required to produce complete Lab Records of the Practical work done by them in

each practical examination, along with other materials prepared or collected as part of Laboratory work / Project.

V. Allthe general rules for examinations (given under item no. X) shall be adhered to.

VI. Acandidate shall be deemed to have fully passed a course, if he/she secures

- A minimum of 40% marks for each theory course in the Semester End Examination (SEE)
- A minimum of 40% marks (E – Grade) for each theory course considering both CIE and SEE.
- A minimum of 50% marks for each Practical/ Drawing/ Project work in the Semester End Examination (SEE)
- A minimum of 50% marks (D – Grade) for each Practical/ Drawing/ Project work considering both CIE and SEE.

Important note: The candidate has to mandatorily appear at the SEE in all the Practical/Laboratory/Drawing Courses irrespective of marks secured under CIE.

VII. In case of hearing impaired, orthopedically handicapped and visually challenged candidates, 10% reduction in pass marks in each subject is admissible as per G.O. Ms. No.150, dated 31-08-2006.

VIII. If a candidate desires to have his/her answer scripts revaluated, he/she can apply for it as per the college norms and notification of the College Examination Branch.

IX. A candidate can also obtain a photocopy of the corrected answer book of the theory courses of SEE only against payment. For more details in this regard, the press note of the College Examination Branch after the declaration ofresults maybe referred.

V. RULES OF PROMOTION

S. No.	Semester / Class	Conditions to be fulfilled	
1.	From I-Semester to II-Semester	Regular programme of study of B.E. I-Semester	
2.	From II-Semester to III-Semester	a)	Regular programme of study of B.E. II-Semester
		b)	Must have earned at least 50% of credits (rounded to the next nearest integer) prescribed for B.E. I-Semester and II-Semester.
3.	From III-Semester to IV-Semester	Regular programme ofstudy of B.E. III-Semester	
4.	From IV-Semester to V-Semester	a)	Regular programme of study of B.E. IV-Semester

		b)	No. of backlog credits, if any of B.E. I, II, III and IV Semester put together shall not exceed 50% (rounded to the next nearest integer) of the total number of credits prescribed for the B.E. III & IV-Semester
5.	From V-Semester to VI-Semester	Regular programme of study of B.E. V-Semester	
6.	From VI- Semester to VII-Semester	a)	Regular programme of study of B.E. VI-Semester
		b)	Number of backlogs credits if any of B.E. I, II, III, IV, V and VI Semester put together shall not exceed 50% (rounded to the next nearest integer) of the total number of credits prescribed for the B.E. V & VI-Semester
7.	From VII-Semester to VIII-Semester	Regular programme ofstudy of B.E. VII-Semester	

Note: 1. If a candidate has more than permitted number ofcredits as backlogs, he/she will be detained.

2. The candidate who wishes to take readmission into the year in which he/she is detained will have to pay the total tuition fee of that year and all the credits earned during that year shall become null and void.

VI. GRADING SYSTEM

1. Candidates who have passed all the examinations of the B.E. Degree Programme shall be awarded Cumulative Grade Point Average (CGPA) in accordance with the grade secured by them in all eight Semesters taken together, including the CIE marks secured in thosesemesters. The grade secured shall be shown in the memorandum of marks as per the performance in CIE and SEE.
A minimum CGPA of 5 is required for the award of Degree. The consolidated memorandum of marks will reflect the credits/ grade scored in each course.

1. Semester Grade Point Average (SGPA) & Cumulative Grade Point Average (CGPA)

Calculation:

a) $$\text{SGPA} = \frac{\sum_{i=1}^{p} (\text{Letter Grade Point}_i \times \text{Credits}_i)}{\sum_{i=1}^{p} \text{Credits}_i}$$

Where i = 1, 2, ….. p represent the number of courses in a particular semester. SGPA is calculated upto second decimal point and it is calculated only when all courses in that semester are Cleared/ Passed.

b) $$\text{CGPA} = \frac{\sum_{j=1}^{m} [(\text{SGPA})_j \times (\text{Total Credits})_j]}{\sum_{j=1}^{m} \text{Total Credits}_j}$$

where j= 1, 2, ….m represent the number of semesters ofthe entire programme.

CGPA at a given point of Semester is calculated upto second decimal point. It is calculated only when total credits earned are equal to total credits prescribed as per scheme upto a semester in which the candidate has last appeared for SEE.

c) Courses in which the candidate has failed are not included in computing SGPA/ CGPA.

VII. AWARD OF DEGREE

The degree of bachelor of engineering will be conferred on candidate who has pursued a regular programme of study of four academic years (three academic years for candidates admitted in II-Year under lateral entry scheme), as hereinafter prescribed in the scheme of instruction and has passed all the examinations as prescribed in the scheme ofexaminations.

Note: For **mandatory and audit courses (non-credit),** student shall be awarded a Grade without any credit. This shall not be counted for the computation of SGPA/CGPA.

VIII. AWARD OF GOLD MEDAL

(i) A student securing highest CGPA in **single attempt** is eligible for award of Gold Medal.

(i) Are admitted student is not eligible for Gold medal.

IX. IMPROVEMENT OF OVERALL SCORE

1. A candidate who wishes to improve his/her overall score may do so within one academic year immediately after having passed all the examinations of the B.E. degree programme, by reappearing in not more than two semesters (all courses pertaining to the semester taken together) examinations without violating the rule mentioned in the item II.3.

2. For the award of the overall score, he/she will have the benefit of the higher SGPA secured in the corresponding semester(s).

X. GENERAL RULES OF EXAMINATIONS

1. Application for permission to appear in any examination shall be made available online through college website (www.mvsrec.edu.in) as per the notification.

2. When a candidate's application is found in order and he/she is eligible to appear in Semester End Examination (SEE), the College Examination Branch shall furnish him with a Hall-Ticket, enabling the candidate to appear in the Semester End Examination. The Hall- Ticket shall have to be produced by the Candidate before he/she is admitted to the premises where the Examination is likely to be held.

3. A candidate who does not present himself/herself for examination for any reason whatsoever, excepting shortage of attendance, shall not be entitled to claim refund of the whole or part of the examination fee, for subsequent Examination(s).

4. A candidate after he/she has been declared successful in the all examinations, shall be given a provisional certificate stating the year of examination, the branch in which he/she was examined and, the overall grade secured. However, the candidates have to obtain degree certificate (convocation) from the Examination Branch, Osmania University, Hyderabad.

5. No candidate shall be allowed to put in attendance for a programme or appear at examinations for different degrees and different faculties simultaneously.

6. Students who have appeared once in any examination of the programme need not put in fresh attendance, if they wish to reappear at the corresponding examination, notwithstanding the fact that the college may have introduced new courses. They will, however, have to appear at the examinations according to the scheme of examination any syllabi in force.

XI. TRANSITORY REGULATIONS

1. Whenever a course or scheme of instruction is changed in a particular semester/year, two more examinations immediately following thereafter shall be conducted according to the old syllabus/regulations, provided the content in the course has changed more than 40%.

2. Candidates not appearing at the examinations or failing in them shall take the examination subsequently according to the changed syllabus/regulations.

XII. RANGE OF CREDITS

1. A regular student will be eligible to get an Under Graduate degree in Engineering if he/she secures the credits as specified in the Scheme of Instruction and Examinations.

   A lateral entry student shall be declared eligible to get an Under Graduate degree in Engineering if he/she

   i. Secures required credits as specified in the Scheme of Instruction and Examinations from Semester - III to Semester - VIII
   ii. Qualifies bridge courses and mandatorycourses specified if any during Semester - I and Semester – II

XIII. MALPRACTICE AND AWARD OF PUNISHMENT

Schedule on the Nature of Malpractice and Award of Punishment

"Examination" in this context refers to all the papers taken by the candidate on the same hall-ticket.

MALPRACTICE AND AWARD OF PUNISHMENT

S. No	Malpractice	Award of Maximum Punishment
1	Possession of the prohibited (written or printed) papers, books, notes during the examination period but which were not used.	Shall be debarred from appearing at the subsequent papers of the examination apart from cancelling the result of the examination in which he/she had indulged in malpractice.
2	Matter relevant to the examination being written on any part of the body or on the clothes worn, or in the instrument, wrapping, etc.	-do-
3	Attempting to take help from any prohibited papers, notes, written or printed matter, writings on the walls, furniture and attempting to take help from or giving help to other regarding answer to any question or questions ofthe examination paper.	-do-

4	Taking help from or consulting of prohibited written or printed material; consulting and/or taking help from or helping other examinee during the examination period inside the examination hall or outside it; with or without their consent, or helping other candidate to receive help from anyone else.	-do-
5	An examinee who attempts to disclose his/her identity to the paper valuer by writing his/her roll number at a place other than the place prescribed for it, or by writing his/her name or any coded message or an examinee who makes an appeal to the paper valuer in the answer book.	Cancelling the result of that paper
6	Writing such as invocation of God's name in any form.	To be ignored
7	Writing on the question paper or other papers; the answer to questions, rough work, etc., with no intention of passing it on to another examinee.	To be warned not to do so.
8	Using abusive and obscene language in the answer book.	Cancellation of the result of that paper
9	Examinee allowing or destroying prohibited material found in his possession or acting in any other manner with a view to destroy evidence.	Cancellation of the result of all examinations taken or proposed to be taken during that session and prohibiting his/her admission to or continuation in any course for a period of one year.
10	Refusing to obey instructions of the Chief Superintendent/Invigilator.	Cancelling the result of that paper
11	Smuggling an answer book/additional answer book/ matter into or out of the examination hall.	Cancellation of the result of all examinations taken or proposed to be taken during that session and prohibiting his/her admission to or continuation in any course for a period of one year.

12	Inserting in or removing from the answer book/additional answer book of any sheet.	-do-
13	Substituting wholly or partly an answer book/additional answer book.	-do-
14	Impersonation even at a single examination.	To be dealt with as per law
15	Cases of examinees when conspiring to interchange in Roll Nos.	Cancellation of the result of all examinations taken or proposed to be taken during that session and prohibiting their admission to any course for a period of one year.
16	Creation of disturbance or otherwise misbehaving in and around the examination hall during or before the examination.	Cancelling the results of all examinations taken or proposed to be taken during that session and prohibiting admission in to or continuation in any course of study for a period of two years.
17	Guilty of assaulting/abusing intimidating any person connected with the examination work any time before, during or after the examination.	Cancelling the result of all examinations taken or proposed to be taken during that session and the next session and prohibiting admission into or continuation in any course for a period of two years.
18	Punishments for malpractices not defined here would be recommended on the merits of the individual cases by the malpractices committee.	

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Annexure -I
Academic Regulations for B.E. with Minor program

From the academic year 2023-24 onwards MVSREC (Autonomous) has introduced a brand new Minor Degree program for the batch admitted in 2021-22 (First Autonomous Bath) to embark on a journey of exploration and expand their knowledge in cutting-edge fields like Data Science, AI&ML, Additive Manufacturing and design, IoT and Innovation & Entrepreneurship.

1. The **Bachelor of Engineering (B. E.) with Minor** program focuses on the fundamental principles of multiple Engineering disciplines, critical & analytical thinking and the ability to develop a distinctive approach to the interdisciplinaryproblems.

The keyobjectives of offering B.E. with Minor program are:

- To expand the domain knowledge of the students in one of the other branches of engineering.
- To increase the employ ability of under graduate students keeping in view of better opportunity in inter disciplinary areas of engineering &technology.
- To provide an opportunity to students to pursue their higher studies in the inter-disciplinary areas in addition to their own branch of study.
- To offer the knowledge in the areas which are identified as emerging Technologies/thrust areas of Engineering.

2. Minor courses and the offering Departments

S.No.	Minor Program	Eligible branch of students	@Offering Department	Award of Degree
1.	Artificial Intelligence & Machine Learning	All branches, except B.E. in IT, CSE and Allied branches	CSE	"B. E. in Branch name with Minor in Artificial Intelligence & Machine Learning"
2.	Data Science	All branches, except B. E In IT, CSE and Allied branches	IT	"B.E.in branch name with Minor In Data Science"
3.	IOT	All branches, except B.E in ECE, CSE(IOT)	ECE	"B.E. in branch name with Minor inIOT"
4.	Innovation and Entrepreneurship	All branches.	Management Science /MBA	"B.E. in branch name with Minor in Innovation and Entrepreneurship"

5.	Sustainable Energy Engineering	All branches, except B.E in EEE	EEE	"B.E.in branch name with Minor in Sustainable Energy Engineering
6.	Construction Management & Administration	All branches, except B.E in Civil Engineering	Civil Engineering	"B.E.in branch name with Minor in Construction Management & Administration
7.	Additive Manufacturing and design	All branches, except B.E in Mechanical Engineering& Auto Mobile Engineering	Mechanical Engineering	"B.E.in branch name with Minor in3D Printing and Design

B. Academic Regulations for B.E. Degree with Minor programs

1. The weekly instruction hours, internal & external evaluation and award of grades are on par with regular 4-Years B. E. program.
2. For B. E. with Minor, a student needs to earn additional 18 credits (over and above the required 160 credits for B. E degree). The list of courses of each Minor program, their respective credits weightage and semester-wise break- up of the courses are enclosed as Annexure. All these 18 credits need to be completed in III year and IV year only.
3. After registering for the Minor programme, if a student is unable to earn all the required 18 credits in a specified duration (n+2), he/she shall not be awarded Minor degree. However, if the student earns all the required 160 credits of B.E., he/she will be awarded only B. E degree in the concerned branch.
4. There is no transfer of credits from Minor program courses to regular B. E. degree course& vice versa.
5. These 18 credits are to be earned from the additional Courses offered by the host department in the college as well as from the MOOCS platform.
6. For the course selected under MOOCS platform following guidelines may be followed:

   a. Prior to registration of MOOCS courses, formal approval of the courses, by the University is essential. University before the issue of approval considers the parameters like the institute / agency which is offering the course, syllabus, credits, duration of the programme and mode of evaluation etc.

b. Minimum credits for MOOCS course must be equal to or more than the credits specified in the Minor course structure provided bythe University.

c. Only Pass-grade/marks or above shall be considered for inclusion of grades in minor grade memo.

d. Any expenses incurred for the MOOCS courses are to be met bythe students only.

7. The choice to opt/take a Minor program is purely on the choice of the students.

8. The student shall be given a choice of withdrawing all the courses registered and/or the credits earned for Minor program at any time; and in that case the student will be awarded only B. E. degree in the concerned branch on earning the required credits of 160.

9. The student can choose only one Minor program along with his/her basic engineering degree.

10. The B.E. with a Minor program shall be offered from the AY 2023-24 onwards. The students who are pursuing their III year I semester in the current academic year can register for the Minor program if they fulfill the eligibility criteria.

11. A student can graduate with a Minor if he/she fulfills the requirements for his/her regular B.E. program as well as fulfills the requirements for Minor program.

Note:-

i. The institute shall maintain a record of students registered and pursuing their Minor programs, program-wise and parent branch- wise. The same report will be sent to the University once the enrolment process is complete.

ii. The Institute / Department will prepare the time-tables for each Minor course offered without any overlap/clash with other courses of study in the respective semesters

5. Eligibility conditions for the student to register for Minor course

a) A student can opt for B.E. degree with Minor program if she/he has good academic record and must have min CGPA of 6.5 till II Year I Semester (III semester) at the time of entering into III year I semester.

b) Prior approval of mentor and Head of the Department for the enrolment into Minor program, before commencement of III year I Semester (V Semester), is mandatory

c) If more than 50% of the students in a branch fulfil the eligibility criteria (as stated above), the number of students given eligibility should be limited to 50%.

6. Registration for the courses in Minor Program

a) At the beginning of each semester, just before the commencement of classes, students shall register for the courses which they wish to take in that semester.

b) The students should choose a course from the list against each semester (from Minors course structure) other than the courses they have studied/registered for regular B.E. programme. No course should be identical to that of the regular B.E course. The students should take the advice of faculty mentors while registering for a course at the beginning of semester.

c) The maximum number of courses for the Minor is limited to two (three in case of inclusion of lab) in a semester along with regular semester courses.

d) The registration fee to be collected from the students by the College is Rs**. 1000/-** per one credit.

e) A fee for late registration may be imposed as per the norms.

R21-BE CSE(IoT-CS-BcT) - SCHEME W.E.F A.Y (2022-26)

S.No.	Course Work – Subject Area	Credits/ Semester								Credits
		I	II	III	IV	V	VI	VII	VIII	
1	Humanities and Social Sciences (HS)	3	2	3	-	-	-	-	-	**8**
2	Basic Sciences (BS)	9	9	3	-	-	-	-	-	**21**
3	Engineering Sciences (ES)	10	5	3	-	-	-	-	-	**18**
4	Professional Subjects –Core (PC)	-	-	12	19	**18**	**14**	**11**	-	**74**
5	Professional Subject-Electives (PE)	-	-	-	-	**3**	**6**	**3**	**3**	**15**
6	Open Subjects – Electives (OE)	-	-	-	-	-	**3**	**3**	**3**	**9**
7	Project Work, Seminar and/or Internships (PW)	-	-	-	1	**2**	-	**2**	**10**	**15**
8	Mandatory Courses (MC) (Non-Credit)	-	-	-	-	-	-	-	-	-
TOTAL		**22**	**16**	**21**	**20**	**23**	**23**	**19**	**16**	**160**
Contact Hours/ Week		**29**	**23**	**26**	**27**	**28**	**28**	**21**	**26**	

R21-BE CSE (IoT-CS-BcT) SEMESTER-I

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P / D	Contact Hrs/ week	CIE	SEE	Duration of SEE (Hrs.)	
Theory Courses										
1	U21BSN01MT	Engineering Mathematics - I	3	1	-	4	30	70	3	4
2	U21BSN01CH	Engineering Chemistry	3	-	-	3	30	70	3	3
3	U21HSN01EG	English	2	-	-	2	30	70	3	2
4	U21ESN01CS	Programming for Problem Solving using C	3	-	-	3	30	70	3	3
5	U22ESN01EC	Basic Electronics and Sensors	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
6	U21BSN81CH	Chemistry Lab	-	-	4	4	25	50	3	2
7	U21HSN81EG	English Laboratory	-	-	2	2	25	50	3	1
8	U21ESN82ME	Basic Workshop Practice	-	-	2	2	25	50	3	1
9	U21ESN81CS	Programming for Problem Solving using C Lab	-	-	4	4	25	50	3	2
10	U22ESN81EC	Basic Electronics and Sensors Lab	-	-	2	2	25	50	3	1
Induction Program			Three weeks before commencement of classwork of semester I							
		Total	**14**	**1**	**14**	**29**	**275**	**600**	**30**	**22**

R21-BE CSE (IoT-CS-BcT) SEMESTER-II

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/ Drg	Contact Hrs/ week	CIE	SEE	Duration of SEE (Hrs.)	
Theory Courses										
1	U21BSN02MT	Engineering Mathematics – II	3	-	-	3	30	70	3	3
2	U21BSN01PH	Engineering Physics	3	-	-	3	30	70	3	3
3	U22ESN02CS	Problem Solving using Python Programming	3	-	-	3	30	70	3	3
4	U21HSN02EG	Effective Technical Communication in English	2	-	-	2	30	70	3	2
5	U21MCN01PO	Indian Constitution	2	-	-	2	30	70	3	-
Practical/ Laboratory Courses										
6	U21BSN81MT	Computational Mathematics Lab	-	-	2	2	25	50	3	1
7	U21BSN81PH	Physics Lab	-	-	4	4	25	50	3	2
8	U22ESN82CS	Problem Solving using Python Programming Lab	-	-	2	2	25	50	3	1
9	U21ESN82CE	Engineering Drawing Practice	-	-	2	2	25	50	3	1
		Total	**13**	-	**10**	**23**	**250**	**550**	**27**	**16**

R21-BE CSE (IoT-CS-BcT) SEMESTER-III

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/ Drg	Contact Hrs/ week	CIE	SEE	Duration of SEE (Hrs.)	
Theory Courses										
1	U21ES301CS	Logic and Switching Theory	3	-	-	3	30	70	3	3
2	U21PC301CS	Database Management Systems	3	-	-	3	30	70	3	3
3	U21PC304CS	Data Structures and Algorithms Using 'C'	3	-	-	3	30	70	3	3
4	U21PC303CS	Discrete Mathematics	2	1	-	3	30	70	3	3
5	U21BSN03MT	Engineering Mathematics – III	3	-	-	3	30	70	3	3
6	U21MCN01CE	Environmental Science	2	-	-	2	30	70	3	-
7	U21HSN01CO	Finance and Accounting	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
7	U21PC381CS	Database Management Systems Lab	-	-	2	2	25	50	3	1
8	U21PC384CS	Data Structures and Algorithms Using 'C' Lab	-	-	4	4	25	50	3	2
		Total	**19**	**1**	**6**	**26**	**260**	**590**	**27**	**21**

R21-BE CSE (IoT-CS-BcT) SEMESTER-IV

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/Drg	Contact Hrs/ week	CIE	SEE	Duration of SEE (Hrs.)	
Theory Courses										
1	U21PCN01CS	Object Oriented Programming using Java	3	-	-	3	30	70	3	3
2	U22PC401CB	Computer Organization and Assembly Language Programming	3	-	-	3	30	70	3	3
3	U22PC402CB	Internet of Things & Applications	3	-	-	3	30	70	3	3
4	U21PC401CS	Design and Analysis of Algorithms	3	-	-	3	30	70	3	3
5	U21PCN06CS	Computer Networks	3	-	-	3	30	70	3	3
6	U21MCN01PY	Essence of Indian Traditional Knowledge	2	-	-	2	30	70	3	-
Practical/ Laboratory Courses										
7	U21PCN81CS	Object Oriented Programming using Java Lab	-	-	4	4	25	50	3	2
8	U22PC481CB	CO & IoT Lab	-	-	2	2	25	50	3	1
9	U21PCN86CS	Computer Networks Lab	-	-	2	2	25	50	3	1
10	U22SI401CB	Industry Training	-	-	2	2	25	-	-	1
		Total	**17**	**-**	**10**	**27**	**280**	**570**	**27**	**20**

R21-BE CSE (IoT-CS-BcT) SEMESTER-V

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			
			L	T	Pr/ Drg	Contact Hrs/ week	CIE	SEE	Duration of SEE (Hrs.)	Credits
Theory Courses-										
1	U22PCN01CB	Web Technologies	3	-	-	3	30	70	3	3
2	U21PCN02CS	Software Engineering	3	-	-	3	30	70	3	3
3	U21PCN04CS	Operating Systems	3	-	-	3	30	70	3	3
4	U21PCN05CS	Automata Languages and Computation	3	-	-	3	30	70	3	3
5	U22PC501CB	Cyber Security	3	-	-	3	30	70	3	3
6	U22PE51XXX	Professional Elective - I	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
7	U22PCN81CB	Web Technologies Lab	-	-	2	2	25	50	3	1
8	U21PCN84CS	Operating Systems Lab	-	-	2	2	25	50	3	1
9	U22PC581CB	Cyber Security Lab	-	-	2	2	25	50	3	1
10	U22PW581CB	Mini-Project	-	-	4	4	25	50	3	2
		Total	**18**	**0**	**10**	**28**	**280**	**620**	**30**	**23**

Professional Elective – I		
S.No.	**Course Code**	**Course Title**
1	U22PE511CB	Compiler Design
2	U22PE512CB	Embedded Systems
3	U22PE513AL	Image Processing
4	U22PE514CB	Service Oriented Architecture
5	U22PE515DS	Game Development

R21-BE CSE (IoT-CS-BcT) SEMESTER-VI

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/ Drg	Contact Hrs/ week	CIE	SEE	Duration of SEE (Hrs.)	
Theory Courses										
1	U22PCN01AL	Distributed Systems and Cloud Computing	3	-	-	3	30	70	3	3
2	U21PC602CS	Artificial Intelligence and Machine learning	3	-	-	3	30	70	3	3
3	U22PC601CB	Cryptography and Network Security	3	-	-	3	30	70	3	3
4	U22PE62XXX	Professional Elective – II	3	-	-	3	30	70	3	3
5	U22PE63XXX	Professional Elective – III	3	-	-	3	30	70	3	3
6	U21OE61XXX	Open Elective – I	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
7	U22PCN81AL	Distributed Systems and Cloud Computing Lab	-	-	2	2	25	50	3	1
8	U21PC682CS	Artificial Intelligence and Machine learning Lab	-	-	4	4	25	50	3	2
9	U22PC683AL	DevOps Lab	-	-	4	4	25	50	3	2
*Summer Internship(U22PW782CB):To be conducted after the VI Semester in Summer Vacation and to be evaluated in VII Semester										
		Total	**18**	**-**	**10**	**28**	**255**	**570**	**27**	**23**

Professional Elective – II		
S.No	**Course Code**	**Course Title**
1	U22PE621DS	Object Oriented System Development
2	U22PE622AL	Mobile Application Development
3	U22PE623CB	Wireless Sensor Networks
4	U22PE624CB	Web 3.0
5	U22PE625CB	Fundamentals of Data Science

Professional Elective – III		
S.No.	**Code**	**Course Title**
1	U22PE631DS	Human Computer Interaction
2	U22PE632CB	Software Project Management
3	U22PE633AL	Introduction to Robotics
4	U22PE634CB	Crypto Currencies
5	U22PE635CB	Natural Language Processing

Open Elective –I		
S.No.	**Code**	**Course Title**
1	U21OE611AE	Automobile Engineering
2	U21OE611CE	Disaster Mitigation
3	U21OE611CS	Fundamentals of Data Structures
4	U21OE611EC	Principles of Electronic Communications
5	U21OE612EC	Electronic Instrumentation
6	U21OE611EE	Electrical Energy Conservation and Safety
7	U21OE611IT	Database Systems
8	U21OE611ME	Operations Research & Techniques
9	U21OE612ME	Industrial Robotics
10	U21OE611EG	Soft skills and Interpersonal Skills

R21-BE CSE (IoT-CS-BcT) SEMESTER-VII

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/ Drg	Contact Hrs/ week	CIE	SEE	Duration of SEE (Hrs.)	
Theory Courses										
1	U22PC701CB	IoT Cloud Processing and Security	3	-	-	3	30	70	3	3
2	U22PC702CB	Blockchain Technologies	3	-	-	3	30	70	3	3
3	U22PC703CB	Digital and Mobile Forensics	3	-	-	3	30	70	3	3
4	U22PE74XXX	Professional Elective – IV	3	-	-	3	30	70	3	3
5	U21OE72XXX	Open Elective II	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
6	U22PC781CB	IoT Cloud Processing and Security Lab	-	-	2	2	25	50	3	1
7	U22PC782CB	Blockchain Technologies Lab	-	-	2	2	25	50	3	1
8	U22PW781CB	Capstone Project Work - I	-	-	2	2	50	-	-	1
9	U22PW782CB	Summer Internship	-	-	-	-	50	-	-	1
		Total	**15**	**-**	**6**	**21**	**300**	**450**	**21**	**19**

Professional Elective – IV		
S.No.	**Code**	**Course Title**
1	U22PE741CB	Intellectual Property Rights
2	U22PE742DS	Multicore Architectures and Programming
3	U22PE743CB	Robotic Process Automation
4	U22PE744CB	Security and Privacy in Social Media
5	U22PE745CB	Deep Learning

Open Elective –II		
S.No.	**Code**	**Course Title**
1	U21OE721AE	Automotive Vehicle Maintenance
2	U21OE721CE	Green Building Technologies
3	U21OE721CS	Principles of Operating Systems
4	U21OE721EC	Basic Navigation Systems
5	U21OE722EC	Principles of Mobile Communications
6	U21OE721EE	Non-Conventional Energy Sources
7	U21OE721IT	Fundamentals of Software Engineering
8	U21OE721ME	Entrepreneurship
9	U21OE721MT	Transform Calculus

R21-BE CSE (IoT-CS-BcT) SEMESTER-VIII

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/ Drg	Contact Hrs/ week	CIE	SEE	Duration of SEE (Hrs.)	
Theory Courses										
1	U22PE85XXX	Professional Elective – V	3	-	-	3	30	70	3	3
2	U21OE83XXX	Open Elective – III	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
3	U22PW881CB	Capstone Project Work - II	-	-	**20**	20	50	150	3	10
		Total	**6**	**-**	**20**	**26**	**110**	**290**	**9**	**16**

Professional Elective – V		
S.No	**Code**	**Course Title**
1	U22PE851AL	Quantum Computing
2	U22PE852DS	Information Retrieval Systems
3	U22PE853CB	Software Quality and Testing
4	U22PE854CB	Fog and Edge Computing
5	U22PE855CB	Bigdata Analytics

Open Elective –III		
S.No.	**Code**	**Course Title**
1	U21OE831AE	Motor Sport Engineering
2	U21OE831CE	Road Safety Engineering
3	U21OE831CS	Artificial Intelligence Techniques
4	U21OE831EC	Fundamentals of IOT
5	U21OE832EC	Principles of Computer Communication and Networks
6	U21OE831EE	Smart Building Systems
7	U21OE831IT	Principles of Information Security
8	U21OE831ME	Material Handling
9	U21OE832ME	Smart Materials and Sensors
10	U21OE831PH	Nano Science

R21-BE CSE (IoT-CS-BcT) SEMESTER-I

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	P / D	Contact Hrs/ week	CIE	SEE	Duration of SEE (Hrs.)	
Theory Courses										
1	U21BSN01MT	Engineering Mathematics - I	3	1	-	4	30	70	3	4
2	U21BSN01CH	Engineering Chemistry	3	-	-	3	30	70	3	3
3	U21HSN01EG	English	2	-	-	2	30	70	3	2
4	U21ESN01CS	Programming for Problem Solving using C	3	-	-	3	30	70	3	3
5	U22ESN01EC	Basic Electronics and Sensors	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
6	U21BSN81CH	Chemistry Lab	-	-	4	4	25	50	3	2
7	U21HSN81EG	English Laboratory	-	-	2	2	25	50	3	1
8	U21ESN82ME	Basic Workshop Practice	-	-	2	2	25	50	3	1
9	U21ESN81CS	Programming for Problem Solving using C Lab	-	-	4	4	25	50	3	2
10	U22ESN81EC	Basic Electronics and Sensors Lab	-	-	2	2	25	50	3	1
Induction Program			Three weeks before commencement of classwork of semester I							
		Total	**14**	**1**	**14**	**29**	**275**	**600**	**30**	**22**

B.E. CSE (IOT-CS- BCT) SEMESTER-I

Course Code	Course Title						Core/ Elective
U21BSN01MT	Engineering Mathematics - I						Core
Prerequisite	Contact Hours per Week				CI E	SEE	Credits
	L	T	D	P			
-	3	1	-	-	30	70	4

Course Objectives

The objectives of this course is to

1. Introduce the concepts of sequences, series and their properties.
2. Introduce the concepts of mean value theorems and curvature.
3. Introduce the concepts of multiple integrals.
4. Study vector differential and vector integral calculus.

Course Outcomes

After completing this course, the student will be able to:

1. Determine the convergence of infinite series using various tests of convergence
2. Solve problems based on the fundamental theorem of differential calculus, find radius of curvature, evaluate and envelopes and expand functions using Taylor & MacLaurin series
3. Evaluate Double and Triple integrals in Engineering Problems
4. Solve problems based on vector differentiation.
5. Solve problems based on vector integration.

UNIT-I

Infinite Series: Introduction to sequences, Infinite series, general properties of infinite series, geometric series, series of positive terms, Harmonic series(p-series),Comparison test, D‟ Alembert‟s ratio test, Raabe‟s test, Cauchy‟s nth root test, Alternating series, absolute and conditional convergence.

UNIT-II

Differential Calculus: Rolle‟s theorem, Lagrange‟s mean value theorem, Cauchy‟s mean value theorem(without proofs) and their applications, Taylor and Maclaurin series, Curvature, Radius of curvature(Cartesian form),Centre of Curvature, Evolute and Involute, Envelope of a family of curves

UNIT-III

Multiple Integrals: Introduction to functions of two and three variables, Double integrals, Change of order of integration, Change of variables from Cartesian to Plane Polar coordinates, Triple integrals(Cartesian)

UNIT-IV

Vector Differentiation: Scalar and vector point functions, Vector operator del, Gradient, Unit normal vector, Directional derivative, Angle between surfaces, Divergence, solenoidal vector, Curl, Irrotational vector, Laplace operator applied to scalar and vector point functions.

UNIT-V

Vector Integration: Line integral-work done, Surface integral, Volume integral, Green‟s theorem in a plane, Stoke‟s theorem, Gauss divergence theorem(without proofs) and their verifications.

Text Books:

1. *R. K. Jain &S. R .K. Iyengar, Advanced Engineering Mathematics, Narosa Publications, 5th Edition 2016.*
2. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 44th Edition, 2018.*

Reference Books:

1. *B.V. Ramana, Higher Engineering Mathematics, 23rd reprint, 2015.*
2. *N. Bali, M. Goyal, A text book of Engineering Mathematics, Laxmi publications, 2010*
3. *Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley, 9th Edition, 2012.*
4. *B. Thomas Jr. and Ross L. Finney Calculus and Analytic Geometry.*
5. *M. Tom. Aposta, l Calculus: One -Variable Calculus with An Introduction to Linear Algebra, Vol* 1

Course Code	Course Title				Core/ Elective		
U21BSN01CH	Engineering Chemistry				Core		
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

The objectives of this course is to

1. To relate how the basic concepts and principles of chemistry can be applied to practical utility in a broader perspective of the society.
2. To distinguish the ranges of electromagnetic spectrum and its interaction with matter and to develop knowledge of various spectroscopic techniques at atomic and molecular levels.
3. To identify and apply various principles of electrochemistry and corrosion which are essential for an engineer in industry
4. To bring adaptability to the concepts of chemistry and to acquire the required skills to become a perfect engineer.
5. To provide an overview of ordinary differential equations and their applications.

Course Outcomes

After completing this course, the student will be able to:

1. Explain and apply the knowledge of various electrodes, electrode potentials and Nernst equation to construct electrochemical cells and thereby to calculate EMF of cell.
2. Analyze different types of corrosion, mechanism, factors affecting metallic corrosion and control corrosion by various methods.
3. Explain the origin of UV-Vis absorption in terms of electronic transitions in determination of structures of various molecules and Analyze microscopic chemistry in terms of atomic and molecular orbitals
4. Identify and make use of various polymers as material for engineering applications.
5. Classify various energy sources and illustrate the importance and applications of renewable and non- renewable energy sources.
6. Relate the concepts liquid crystals, composites and green chemistry to modify engineering processes and materials.

UNIT – I

Electro Chemistry &Corrosion and It's control (9 Periods): Electro Chemistry: Electrochemical Cells-Electrolytic and galvanic cells-notation.Cell Reaction and Cell EMF.Electrodepotential, Standard electrode potential. Electrochemical series and Applications. Free Energy and EMF. Nernst equation and its derivation, Applications -Numerical problems. Types of electrodes-Standard hydrogen electrode, Calomel electrode Silver-Silver Chloride, Quinhydrone and glass electrodes. Determination of pH using Quinhydrone electrode coupled with saturated Calomel electrode.

Corrosion: Definition,Causes and effects. Types of corrosion, Chemical corrosion, and its mechanism. Electrochemical corrosion and its mechanism.Galvanic corrosion, Concentration cell Corrosion-Waterline and Pitting corrosion. Factors effecting rate of corrosion. Corrosion control methods- Cathodic Protection –Sacrificial anode and impressed current cathode methods. Surface Coatings-Types. Electro plating and Electroless plating of metal coatings.

UNIT-II

Molecular Structure & Spectroscopic techniques (9 Periods): Regions of electromagnetic spectrum, Molecular spectroscopy. Rotational Spectroscopy: Rotation of molecules, rotational spectra of rigid diatomic molecules, selection rules.Vibrational Spectroscopy: The vibrating diatomic molecule, simple and anharmonic oscillators of a diatomic molecule, selection rules, applications of IR spectroscopy. NMR Spectroscopy: Criteria for NMR activity (Magnetic and nonmagnetic nuclei), basic concepts and principle of ^{1}H NMR spectroscopy, Chemical shift, Magnetic Resonance Imaging.

UNIT-III

Polymeric Materials (9 Periods): Polymers: Basic terminology - Monomer and its functionality, Polymers, and degree of polymerization. Types of Polymerizations- Chain Growth,Step Growth Polymerization – Examples. Plastics, Fibers, Elastomers – Characteristics and Examples. Preparation, Properties & Uses of the following polymers- PVC, Bakelite,Nylon 6:6,Buna-S, Butyl Rubber and Silicone Rubber. Conducting polymers: Concept, Classification of conducting polymers with examples. Mechanism ofconduction in trans Poly-acetylene.Enhancement of conduction by doping. Applications of conducting polymers. Biodegradable polymers: Concept, Preparation, Properties, and applications of polylactic acid.

UNIT-IV

Energy Sources (9 Periods): Introduction-Renewable and non-renewable energy sources with Examples. Chemical fuels:Definition, Classification of chemical fuels-primary, Secondary and Solid, Liquid, Gaseous fuels -examples. Solid fuels: Coal& its composition, and its rankingLiquid fuels: Petroleum- Fractional distillation of petroleum. Cracking and its significance. Knocking, Octane Numberand Cetane number. Gaseous Fuels: LPG, CNG-composition, properties and uses.Biodiesel: Concept -Transesterification- Carbon neutrality. Advantages of Biodiesel. Batteries: Definition, Types of batteries-Primary batteries; Zn-Carbon battery. Secondary batteries; Construction, working & applications of Lead-acid, Lithium -ion batteries. Fuel cells: Definition, Types of fuels cells, Construction, Applications of working of H2-O2fuel cellsand Methanol-O2fuel cells. Solar cells: Concepts of photovoltaic cell and its applications.

UNIT-V

Liquid Crystals,Composites,and GreenChemistry (9 Periods): Liquid Crystals:Introduction, classification of liquid crystals-Thermotropic and Lyotropic liquid crystals - Chemical constitution & liquid crystalline behavior. Molecular ordering in liquid crystals- Nematic, Smectic and Cholesteric liquid crystals - Applications. Composite materials:Concept,composition, and characteristic properties of composites.Classification of composites based on matrix, reinforcement, and ply. Advantages and applications of composites. Green Chemistry:Concept, Principles of green Chemistry with Examples.

Text Book:

1. *PC Jain, M Jain Engineering Chemistry, Dhanapathi Rai and sons (16th edition), New Delhi*

Reference Books:

1. *Sashi Chawla, Textbook of Engineering Chemistry, Dhanapathi Rai &sons, New Delhi.*
2. *O.G. Palanna, Engineering Chemistry, TMH Edition.*
3. *Puri, Sharma and Pathania Principles of physical chemistry, Vishal Publishing Co.*
4. *Polymer chemistry by Gowariker.*
5. *Fundamentals of Molecular Spectroscopy, by C.N. Banwell, McGraw Hill Publication.*
6. *Fundamentals ofSpectroscopy by Y. R. Sharma.*
7. *Shikha Agarwal, Engineering Chemistry fundamentals and applications, Cambridge University press.*

Course Code	Course Title						Core/Elective
U21HSN01EG	English						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	2	-	-	-	30	70	2

Course Objectives

The objectives of this course is to enhance the English language abilities of students by

1. Using authentic material for language learning.
2. Developing appreciation to a variety of content-rich texts.
3. Strengthening their grammar and vocabulary.
4. Improving reading and comprehension skills and also encouraging them to think critically and creatively.
5. Honing their writing skills.

Course Outcomes

After completing this course, the student will be able to:

1. Demonstrate the skill of reading to summarize, paraphrase and give an accurate account of authentic texts of various genres.
2. Infer and make predictions based on the comprehension of a text.
3. Employ Academic Vocabulary appropriately with a distinction of its formal and informal use
4. Apply different reading strategies to comprehend different texts and decode new words encountered.
5. Undertake guided and extended writing using accurate grammatical structures and vocabulary.

UNIT - I

Reading	:	A.G. Gardener – "On Saying Please"
Vocabulary	:	Word formation-Prefixes, Suffixes, Root Words
Grammar	:	Articles, Prepositions, Determiners
Writing	:	Guided Writing (Expanding the outline/Writing from verbal cues)

UNIT - II

Reading	:	Fritz Karinthy – "Refund "
Vocabulary	:	Word formation- Compounding and Blending, Contractions
Grammar	:	Transitions, Connectives
Writing	:	Paragraph-writing

UNIT - III

Reading	:	Narayan Murthy – "Value System"
Vocabulary	:	Synonyms, Antonyms, One Word Substitutes
Grammar	:	Voice
Writing	:	Letter-writing

UNIT - IV

Reading	:	Robert Frost – "Stopping by Woods on a Snowy Evening"
Vocabulary	:	Homophones, Homonyms, Homographs
Grammar	:	Narration (Direct-Indirect Speech)
Writing	:	Precise writing

UNIT – V

Reading		Stephen Leacock – "On the Need for a Quiet College"
Vocabulary		Inclusive Language, Euphemisms
Grammar		Tenses
Writing		Paraphrasing and Summarizing

Reference Books:

1. *Board of Editors. Language and Life: A Skills Approach. Orient BlackSwan, 2018.*
2. *Sudharshana, NP and C Savitha, English For Engineers. Cambridge University Press, 2018.*
3. *Kumar, Sanjay and Pushp Lata, English Language and Communication Skills for Engineers. Oxford University Press,*
4. *Mark Cholij .Towards Academic English – Developing Effective Writing Skills, Foundation Books, CUP , 2007.*
5. *Terry O"Brien Little Red Book – Perfect Written English . Rupa Publications, 2012.*
6. *Murphy Raymond . Intermediate English Grammar. CUP 2nd Edition, 2016.*
7. *Lott"s Hester - Senior School Grammar and Composition .Orient Black Swan privateLtd., 2018*
8. *Mathur Archana. Become Proficient in Speaking and Writing - Good English V&S Publishers, 2013*

Course Code	Course Title						Core/Elective
U21ESN01CS	Programming for Problem Solving Using C						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

The objectives of this course is to impart knowledge of

1. To introduce the concept of computing environment, number systems, algorithms, flowcharts and implementation using variables with various data types and selection statements.
2. To introduce the logic building techniques using control statements and arrays.
3. To understand modular and structure programming using functions and strings.
4. To learn the alternative to iteration using recursion and familiarization with structures and macros.
5. To understand memory management using pointers and dealing with files.

Course Outcomes

After completing this course, the student will be able to:

1. Formulate simple algorithms/flowcharts there by translating them into programs using variables with various data types and selection statements.
2. Implement logic building techniques using control statements and arrays.
3. Apply modular and structure programming using functions and strings.
4. Analyze the iteration with recursion and implementation of structures and macros.
5. Illustration of memory management techniques using pointers and implement the file handling approach.

UNIT-I

Introduction to computers: Introduction to components of a computer system, Operating system, Number system: Decimal, binary, octal, hexa decimal systems.
Algorithms/Flowcharts: Logical and Numerical problem solving.
Introduction to C Programming: Structure of C, Execution phases in C (Compiler, interpreter, Linker, loader), C-tokens, syntax & semantics in compilation, Identifiers, variables, keywords, Data Types, Operators, precedence & associativity rules, Expression evaluation, Type conversion.
Selection statements: simple if, if-else, else-if ladder, nested if-else, switch.

UNIT-II

Iteration statements: while, do-while, for, **Unconditional statements:** break, continue, goto, return
Arrays: 1-D arrays, **Searching Techniques:** Linear, binary search, **Sorting algorithms:** bubble sort and selection sort,2-D arrays: Matrices.

UNIT-III

Strings: Defining & initializing strings, String manipulation functions (predefined, user-defined)
Functions: Taxonomy of functions, built-in functions, parameter passing techniques: call by value, Passing arrays to functions: Idea of call by reference.
Storage classes: auto, register, static, extern.

UNIT-IV

Recursive functions: Recursion definition, Iteration vs Recursion, Example programs: GCD, Factorial, sum of digits, fibonacci **Structures:** Defining & accessing structured data, Array of structures, passing structure to function, nested structures, Difference between structure & union
Preprocessor directives: Macros, #define, #if, #elif

UNIT-V

Pointers: Introduction to pointers, Defining pointers, pointer arithmetic, Array of pointers, pointer to array, Null pointer, generic pointer, double pointers, passing pointer to function: call by address, Accessing structure using pointer, self-referential structure, Dynamic memory allocation
File Handling: I/O streams, File operations, file modes, Sequential/Random accessing files, command line arguments.

Text Book:

1. *B.A. Forouzan and R.F.Gieverg, "A structured Programming Approach in C" language learning 2013.*

Reference Books:

1. *"C How to program" by Paul Deitel & Harvey Deitel 7th edition,PHI.*
2. *"Computer Fundamentals and Programming in C" - A.K. Sharma,Universities Press,2nd edition,2018*
3. *"Programming in ANSI C" - E. Balagurusamy, TMH, 2008.*
4. *Byron Gottfried - "Theory and practice of Programming with C", Schaum"s Outline McGrawHill,1990.*
5. *"Programming in C"- Pradip Dey,Manas Ghosh, Oxford University Press, 2nd edition.*
6. *Brian W Kernighan and Dennis M Ritchie, "The C programming Language", Prentice Hall of India,1988.*

Course Code	Course Title						Core/Elective
U22ESN01EC	Basic Electronics and Sensors						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Engineering Physics	3	-	-	-	30	70	3

Course Objectives :

1. Understand the characteristics of PN diode, zener diode, and illustrate their applications as rectifier and regulator.
2. Understand the construction and characteristics of transistors (BJT & FET) and analyze small signal model of CE amplifier
3. Classify negative feedback amplifiers, oscillators and analyze their parameters.
4. Understand the working of different transducers and their applications.
5. Study of sensors and Data acquisition system.

Course Outcomes :

1. Illustrate the applications of PN and Zener diode.
2. Explain the structure and working of BJT & FET and analyze their characteristics.
3. Classify Feedback Amplifiers & Oscillator circuits.
4. Demonstrate the applications of Transducers.
5. Classify sensors and demonstrate their applications.

UNIT- I

PN Junction Diode: Formation, characteristics and application. Rectifiers: types of rectifiers, ripple factor, efficiency, PIV, TUF of half wave rectifier and full wave center tapped rectifier, comparison of rectifiers. Filters: Types of filters and circuits. Zener diode: Construction, characteristics, application as regulator.

UNIT-II

Transistor: BJT (N-P-N) construction, working, biasing, modes (regions) of operation, configuration (CB,CE, CC) comparison, characteristics of CE configuration, BJT as an amplifier(CE), Exact and approximate h-parameter model, analysis of CE amplifier using approximate h-parameter model. FET: (Qualitative treatment only) (N-Channel) JFET construction, working, V-I characteristics, parameters, comparison with BJT.

UNIT-III

Feed Back: Concept, block diagram, types, comparison, negative feedback, advantages, gain, bandwidth, Topologies of four negative feedback amplifier. Oscillators: (Qualitative Treatment) RC phase shift, Hartley, Colpitts and Crystal oscillator.

UNIT-IV

Transducers: Definition, classification, requirements, construction and operation of strain guage, LVDT and capacitive transducers to measure force. Temperature Transducers: Resistance Thermometers, Thermistor, Thermo couple.

UNIT-V

Sensors: Definition, Characteristics of Sensors, Light Sensors: Photo Diode, LDR, LED, LCD. Data Acquisition System: Block Diagram, working principle of R-2R Ladder, Digital to Analog converter, successive approximation, Analog to Digital converter, SCADA.

Text Books:

1. *S.Salivahanan, N.Suresh Kumar, Electronic Devices and Circuits, McGraw Hill Education, 4th edition.*
2. *Patranabis, Sensors and Transducers, PHI 2nd Edition 2013.*

References:

1. *Millman and Halkias, "Integrated electronics" - Tata Mcgraw-hill.*
2. *Robert Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 11th ed., Pearson India Publications, 2015*

e-Resources:

1. *Basic Electronics and Lab, IIT Madras, Prof. T.S. Natarajan - https://nptel.ac.in/courses/122106025*
2. *Sensors and Actuators, By Prof. Hardik Jeetendra Pandya, IISc Bangalore - https://archive.nptel.ac.in/courses/108/108/108108147/*

Course Code	Course Title						Core/Elective
U21BSN81CH	Chemistry Lab						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	4	25	50	2

Course Objectives

During the course the student is expected to

1. Introduce practical applications of chemistry concepts to solve engineering problems.
2. Measure the molecular or ionic properties such as conductance, redox potentials.
3. To determine the rate constant of reactions from concentrations as a function of time.
4. Know the laboratory practices implemented in a research and industrial chemistry laboratory setting.
5. To learn to Synthesize polymers

Course Outcomes

After completing this course, the student will be able to:

1. Estimate the hardness of water sample.
2. Apply the principles of Electrochemistry & Colorimetry in quantitative estimations.
3. Measure the properties of liquids such as surface tension and Viscosity.
4. Estimate the rate constants, of reactions from concentration of reactants/ products as a function of time.
5. Synthesize Polymer.

List of experiments:

1. Estimation of Fe (II) by Permanganometry.
2. Estimation of Fe (II) by Dichrometry.
3. Estimation of hardness of water by EDTA method.
4. Estimation of HCl by Potentiometry.
5. Potentiometric estimation of Iron Fe (II) by Permanganometry.
6. Estimation of HCl by Conductometry.
7. Estimation of CH3COOHby Conductometry.
8. Estimation of HCl & CH3COOH in mixture by Conductometry.
9. Estimation of HCl by pH metry.
10. Verification of Beer-Lamberts Law and estimation of Manganese in KMnO4by Colorimetry.
11. Determination of viscosity of liquids using Oswald‟s viscometer
12. Determination of Surface tension by using Stalagmometer.
13. Synthesis of nylon 6,6.
14. Determination of rate constant of acid catalyzed hydrolysis of methyl acetate.
15. Determination of Partition Coefficient of CH3COOH in n-Butanol and Water.

Text Book:

1. *Vogel"s text book of Practical organic chemistry, 5thEdition.*

Reference Books:

1. *Senior Practical Physical Chemistry, B.D. Khosala, A. Gulati and V. Garg (R. Chand & Co.,Delhi)*
2. *Text book on experiments and Calculations in Engineering Chemistry-S.S.Dara.*
3. *An introduction to practical chemistry, K.K. Sharma and D.S. Sharma (Vikas Publications, NewDelhi)*
4. *Laboratory manual on Engineering Chemstry,S.K.Bhasin& Sudha Rani (Dhanpat Rai Publishing Company)*

Course Code	Course Title						Core/ Elective
U21HSN81EG	English Laboratory						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	25	50	1

Course Objectives

The objectives of this course is to enhance the listening and speaking skills of students by

1. Giving them sufficient practice in listening with comprehension.
2. Providing them ample opportunities to improve their public speaking skills.
3. Training them in the use of correct pronunciation, stress, and intonation.
4. Sensitizing them to the use of verbal and non-verbal communication appropriate to the context.
5. Encouraging them to learn the art of conversation to suit formal and informal situation.
6. Preparing them to make formal presentations and face interviews.

Course Outcomes

On successful completion of the course, the student will be able to:

1. Listen, understand, and interpret formal and informal spoken language
2. Speak English with acceptable pronunciation, stress, and intonation
3. Present themselves with confidence in formal situations
4. Be able to perform in fluency, accuracy and time management based activities such as JAM and Picture Perception
5. Participate in individual and group activities with relative ease.

List of Activities

1. Listening for Comprehension
2. Pronunciation, Intonation, Stress, and Rhythm
3. Conversation Skills
4. Introducing Oneself and others
5. Asking for and Giving Information
6. Making Requests and Responding to them Appropriately
7. Giving Instructions and Responding to them Appropriately
8. Making Formal Announcements and Emceeing
9. Picture Perception
10. JAM
11. Role play
12. Group Discussions
13. Interview Skills
14. Presentation Skills

Reference Books:

1. *Board of Editors. Language and Life: A Skills Approach. Orient BlackSwan, 2018.*
2. *Balasudbramanian, T. A Textbook of English Phonetics for Indian Students. Macmillan, 1981*
3. *CIEFL. EXERCISES IN Spoken English. Parts. I- III. Oxford University Press. Pillai,*
4. *Radhakrsihna G. Spoken English For You – Level II. 8the Edition. Emerald Publishers, 2014.*
5. *Sethi, J and PV Dhamija. A Course in Phonetics and Spoken English. 2ndEdition. Prentice Hall India Learning Private Limited, 1999.*

Course Code	Course Title						Core/ Elective
U21ESN82ME	Basic Workshop Practice						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	2	-	25	50	1

Course Objectives

The objectives of this course is to

1. Identify and use marking out tools, hand tools, measuring equipment and to work to prescribed tolerances.
2. To provide hands on experience about use of different engineering materials, tools, equipment's and processes those are common in the engineering field.
3. To gain a good basic working knowledge required for the production of various engineering products.
4. To study different hand operated power tools, uses and their demonstration.
5. Adopt safety practices while working with various tools.

Course Outcomes

After completing this course, the student will be able to:

1. Demonstrate an understanding of and comply with workshop safety regulations.
2. Identify and apply suitable tools for different trades of Engineering processes including material removing, measuring and chiselling.
3. Undertake jobs connected with Engineering Workshop trades including sheet metal and house wiring.
4. Apply basic electrical engineering knowledge for house wiring practice.

A. TRADE FOR EXERCISES:

Course Objective: To impart hands-on practice on basic engineering trades and skills.

1. **House wiring**-Exercises-Single lamp, parallel/Series connection of 2 bulbs and Stair case wiring.
2. **Sheet metal**-Forming and Bending. Model making. Exercises-Taper Tray, Open Scoop, Funnel.

B. IT WORKSHOP: Computer hardware, identification of parts, Disassembly, Assembly of computer to working condition, operating system installation.

1. System Assembling, Disassembling and identification of Parts / Peripherals
2. Operating System Installation-Install Operating Systems like Windows, Linux along with necessary Device, Drivers.
3. MS-Office / Open Office
   a) Word - Formatting, Page Borders, Reviewing, Equations, symbols.
   b) Spread Sheet - organize data, usage of formula, graphs, charts.
   c) Power point - features of power point, guidelines for preparing an effective presentation.
   d) Access- creation of database, validate data.
4. Trouble Shooting-Hardware trouble shooting, Software trouble shooting.

Reference Books:

1. *Venugopal.K, "Workshop manual", Anuradha Publications, Kumbakonam, TN, 2012*
2. *K.C. John, "Mechanical Workshop" 2ndEdn., PHI, 2010.*
3. *Hajra Choudary, "Elements of Workshop Technology" Vol. 1, Asian Publishers, Edn., 1993.*
4. *Computer Hardware, Installation, Interfacing, Troubleshooting and Maintenance, K.L. James, Eastern. Economy Edition.*

Note: *At least three exercises to be done from each trade.*

Course Code	Course Title						Core/ Elective
U21ESN81CS	Programming for Problem Solving Using C Lab						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	4	25	50	2

Course Objectives

1. The objectives of this course is to impart knowledge of
2. Understand the fundamentals of programming in C Language.
3. Write, compile and debug programs in C.
4. Formulate solutions to problems and implement them in C.
5. Effectively choose programming components to solve computing problems.
6. To apply the sorting and searching techniques on given set of data.

Course Outcomes

1. After completing this course, the student will be able to:
2. Choose appropriate data type for implementing programs in C language.
3. Design and implement modular programs involving input output operations, decision making and looping constructs.
4. Implement search and sort operations on arrays.
5. Apply the concept of pointers for implementing programs on dynamic memory management and string handling.
6. Design and implement programs to store data in structures and files.

Write C programs for following:

1. Express and compute few mathematical equations in C language

Selection statements:

2. Finding roots of a quadratic equation
3. Implement arithmetic calculator using switch
4. Check whether entered year is a leap year or not

Iteration statements:

5. Find maximum and minimum value in a given set of numbers
6. Print multiplication table of value X upto Y times
7. Print prime numbers between M & N, Check for armstrong number or not
8. Convert a decimal number to binary and vice versa
9. Display pyramid of numbers and pascal triangle upto N rows

Arrays:

10. Find maximum, minimum and sum of all numbers in a 1-D array
11. Implement linear & binary search using 1-D array
12. Implement bubble sort & selection sort using 1-D array
13. Find the sum and product of two matrices using 2-d arrays
14. Check whether a matrix is an identity matrix or not using 2-d arrays
15. **Programs on Strings:** perform string manipulation functions , convert a lowercase string into uppercase

16. Demonstrate on call by value & call by reference using functions
17. **Programs on Recursion:** GCD, sum of digits, fibonacci series, factorial Structures & Union:
18. Using an array of structures, Store 5 students information (name, roll no, subject1,subject2,subject3,total_marks), compute total_marks of each student and display details of each student.
19. Store 3 employee information (name, salary, designation) and access each employee using union.

Pointers:

20. Demonstrate on pointer arithmetic
21. Find the biggest and smallest of array using pointer to array
22. Implement dynamic memory allocation

Files:

23. Writing/reading/appending some data to a file
24. Copy the contents of one file to other file
25. Count the frequency of characters, lines and words in a given file

Text Books:

1. *"C How to program" by Paul Deitel & Harvey Deitel 7th edition,PHI*
2. *"Computer Fundamentals and Programming in C" - A.K. Sharma, Universities Press,2nd edition,2018*
3. *"Programming in ANSI C" - E. Balagurusamy, TMH, 2008*
4. *Byron Gottfried - "Theory and practice of Programming with C", Schaum"s Outline McGrawHill,1990*
5. *"Programming in C"- Pradip Dey,Manas Ghosh, Oxford University Press, 2nd edition*
6. *Brian W Kernighan and Dennis M Ritchie, "The C programming Language", Prentice Hall of India,1988*

Course Code	Course Title						Core/Elective
U22ESN81EC	Basic Electronics and Sensors Lab						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Engg. Physics Lab	-	-	-	2	25	50	1

Course Objectives :

1. Understand the characteristics of Diode
2. Study the Transistor configurations
3. Study the characteristics of FET
4. Understand the concepts of oscillators
5. Study the characteristics of sensors

Course Outcomes :

1. Analyze diode circuits and application.
2. Analyze the characteristics of BJT's and FET's
3. Understand RC and LC oscillator circuits and calculate the frequency of oscillation
4. Understand the characteristics of various sensors

List of Experiments :

1. CRO applications, Measurements of R,L and C using LCR meter
2. Characteristics of semi-conductor Diodes (Si, Ge and Zener)
3. Half wave and Full wave rectifiers
4. Zener diode as a voltage regulator
5. Static characteristics of BJT-Common emitter configuration
6. Static characteristics of FET
7. Study of CE Amplifier
8. RC-phase shift oscillator
9. Hartley and Colpitts oscillator
10. Characterize the temperature sensor (Thermister)
11. Study the characteristics of photo diode

*** Note: Minimum of 8 experiments to be done**

R21-BE CSE (IoT-CS-BcT) SEMESTER-II

S. No	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/ Drg	Contact Hrs/ week	CIE	SEE	Duration of SEE (Hrs.)	
Theory Courses										
1	U21BSN02MT	Engineering Mathematics – II	3	-	-	3	30	70	3	3
2	U21BSN01PH	Engineering Physics	3	-	-	3	30	70	3	3
3	U22ESN02CS	Problem Solving using Python Programming	3	-	-	3	30	70	3	3
4	U21HSN02EG	Effective Technical Communication in English	2	-	-	2	30	70	3	2
5	U21MCN01PO	Indian Constitution	2	-	-	2	30	70	3	-
Practical/ Laboratory Courses										
6	U21BSN81MT	Computational Mathematics Lab	-	-	2	2	25	50	3	1
7	U21BSN81PH	Physics Lab	-	-	4	4	25	50	3	2
8	U22ESN82CS	Problem Solving using Python Programming Lab	-	-	2	2	25	50	3	1
9	U21ESN82CE	Engineering Drawing Practice	-	-	2	2	25	50	3	1
		Total	**13**	**-**	**10**	**23**	**250**	**550**	**27**	**16**

Course Code	Course Title						Core /Elective
U21BSN02MT	Engineering Mathematics - II						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

The objectives of this course is to

1. Provide an overview of ordinary differential equations and their applications.
2. Study Linear algebra and its uses in solving system of linear equations.
3. Study Eigenvalue problems and Quadratic forms.
4. Study the special functions Gamma and Beta functions.

Course Outcomes

After completing this course, the student will be able to:

1. Solve first order differential equations.
2. Solve higher order differential equations.
3. Solve system of linear equations.
4. Solve eigenvalue problems and Quadratic forms.
5. Apply Beta and Gamma Functions to evaluate definite integrals

UNIT-I

Differential Equations of First Order (13 hours): Exact differential equations, Integrating factors, Linear differential equations, Bernoulli‟s and Riccati‟s. Applications of first order differential equations - Orthogonal trajectories of a given family of curves(Cartesian form)Newton‟s Law of Cooling, Growth and Decay.

UNIT-II

Differential Equations of Higher Order (12 hours): Solutions of second and higher order linearhomogeneous equations with constants coefficients,Solutions of non-homogeneous linear differential equations with constants coefficients, Method of reduction of order, Method of variation of parameters,Applications of second order differential equations-LCR circuits.

UNIT-III

Matrices (10 hours):: Rank of a matrix, Elementary Row/Column operations, Echelon form, Normal form, Linear dependence and independence of vectors, System of linear equations, Linear transformation.

UNIT-IV

Eigenvalues and Eigenvectors (10 hours): Eigenvalues, Eigenvectors, properties of Eigenvalues,Cayley -Hamilton theorem(without proof), Quadratic forms, Reduction of quadratic form to canonical form, Rank, Index, Signature and Nature of quadratic forms.

UNIT-V

Special Functions (10 hours): Gamma function, Beta function, properties of Gamma and Beta functions, relation between Beta and Gamma functions, evaluation of definite integrals using Beta and Gamma functions.

Text Books:

1. *R. K. Jain & S .R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publications, 5th Edition 2016.*
2. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 44thEdition,2018.*

Reference Books:

1. *B.V. Ramana, Higher Engineering Mathematics, 23rd reprint, 2015.*
2. *N. Bali, M. Goyal, AtextbookofEngineeringMathematics, Laxmi publications, 2010*
3. *Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley, 9th Edition, 2012.*
4. *B. Thomas Jr. and Ross L. Finney Calculus and Analytic Geometry.*
5. *M. Tom. Aposta, l Calculus: One -Variable Calculus with An Introduction to Linear Algebra, Vol 1*

Course Code	Course Title						Core/ Elective
U21BSN01PH	Engineering Physics						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

The objectives of this course is to

1. To introduce principles of Wave Mechanics and Electromagnetic theory
2. To explain the properties and applications of semiconducting materials
3. To explain the properties and applications of Magnetic and Superconducting materials
4. To explain the principles of Laser technology, Optical fibers and their applications in various disciplines
5. To introduce Nano Science and Nanotechnology

Course Outcomes

1. After completing this course, the student will be able to:
2. Recall the principles of Wave Mechanics and apply them to solve particle in a box, list the fundamental laws of electricity and magnetism and make use of these laws to derive Maxwell‟s Electromagnetic wave equation and Poynting theorem.
3. Explain and illustrate Semiconducting materials along with their applications.
4. Classify Magnetic Materials and explain properties, Identify applications of Ferro Magnetic Materials and Superconducting Materials.
5. Explain the principle of Laser and Optical Fiber; Summarize different types of Laser sources and optical fibers; identify the applications of Laser and Optical Fiber.
6. Summarize various types of Nanomaterials, their preparation methods and list out various
7. Characterization Techniques and applications of Nanomaterials.

UNIT-I

WAVE MECHANICS AND ELECTROMAGNETIC THEORY (8): De-Broglie‟s hypothesis, Wave function and its physical significance, Schrodinger‟s time independent wave equation, Schrodinger‟s time dependent wave equation, Particle in 1D potential box. Gauss‟s laws in electrostatics and magnetostatics, Faraday‟s law and Ampere‟s law in Electromagnetic induction, Maxwell‟s equations in Integral and differential forms, Conducting current and Displacement current, Electromagnetic wave equation in dielectric medium, Poynting theorem.

UNIT-II

SEMICONDUCTORS AND DEVICES (8): Introduction to Semiconductors - Intrinsic and Extrinsic Semiconductors, Concept of hole, Expression for Carrier concentration and conductivity in Intrinsic Semiconductors, Hall Effect and its applications. Semiconductor devices P-N junction diode, LED,Thermistor.

UNIT-III

MAGNETIC MATERIALS AND SUPER CONDUCTORS (8): Introduction- Basic definitions of magnetism- Origin of Magnetic moment, Classification of Magnetic materials- Dia, Para, Ferro, Anti-ferro and Ferri Magnetic materials Types of magnetic materials and their properties, Weiss molecular field theory of Ferromagnetism, Hysteresis of Ferromagnetic material based on domain theory, Soft and Hard magnetic materials, Ferrites and their applications.

Superconductors and their properties, Meissner effect, Type-I and Type-II Superconductors, BCS Theory, High Tc superconductors, Applications of Superconductors.

UNIT-IV

MODERN OPTICS (8): Introduction to LASERs, Characteristics of Lasers, Spontaneous and Stimulated emissions, Components of LASERs, LASERs operating in UV- Vis-IR Regions, Types of LASERS- Solid State LASER (RUBY LASER), Gas LASER (He-Ne Laser), and Semiconductor LASER, Applications of LASERs.

Introduction to Optical fibre, Basic principle – Total internal reflection, Propagation of light through the fibre - Numerical Aperture and Acceptance angle, Step-Index and Graded- Index optical fibres, Applications of Optical fibres.

UNIT-V

NANO MATERIALS AND EXPERIMENTAL TECHNIQUES (8) : Origin of Nano Science- Bulk and Nano materials, types of nanomaterials, Surface to volume ratio and Quantum confinement effect, properties of nanomaterials, fabrication of nanomaterials- Top-down approach and Bottom-up approach, Ball milling method**,** and Sol-Gel methods, Elementary ideas of Carbon nanotubes (CNT‟S)**.** Material characterization techniques- X- Ray diffraction, RAMAN Spectroscopy, SEM and TEM, Applications of nanomaterials.

Text Books:

1. *M.S. Avadhanulu and P.G. Kshirasagar, A text book Engineering Physics, S. Chand and Co., 9th edition, 2010.*
2. *R.K. Gaur and S.L. Gupta, Engineering Physics, Dhanpat Rai publications, 8th edition, 2001.*
3. *B.K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Learning India(P) Ltd., 2012*
4. *R. Murugesan and K. Sivaprasath, Modern Physics, S. Chand & Company, 13th edition, 2007.*
5. *A. Goswami, Thin Film Fundamentals, New Age International, 2007.*
6. *A.K. Bandopadhyay, Nano Materials, New Age International, 1st edition, 2007.*
7. *Engineering Physics by M. Armugam*
8. *Engineering Physics by K.J. Pratap, et. al.applications, Cambridge University press.*

Course code	Course Title						Core/Elective
U22ESN02CS	Problem Solving using Python Programming						Core
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives:

The objectives of this course is to impart knowledge of

1. Enabling students to learn basic fundamentals of python.
2. To improve logical skills by working with control statements, mathematical functions.
3. To learn about modular programming through functions and recursive programs.
4. To handle logical, syntax errors and define custom errors as per real world problems.
5. Enabling students to learn python built-in modules.

Course Outcomes:

After completing this course, the student will be able to:

1. Implement basic syntax, semantics in python and improve logical skills.
2. Formulate mathematical computations, store data using strings, collection types.
3. Perform modular programming using functions and recursion.
4. Apply basic data structures of python to solve problems.
5. Handle and define multiple exceptions logically, syntactically and also able to access files.

UNIT-I

Basics of Python Programming : Features of Python, Writing and Executing First Python Program, Literal Constants : Numbers Strings, Variables and Identifiers Data Types: Assigning or Initializing Values to Variables, Multiple Assignment, Multiple Statements on a Single Line, Boolean Input Operation, Comments, Reserved Words, Indentation, Operators: and Expressions Arithmetic Operators Comparison Operators Assignment and In-place or Shortcut Operators Unary Operators Bitwise Operators Shift Operators Logical Operators Membership Operators Identity Operators, Operators Precedence and Associativity, Expressions in Python, Operations on Strings, Concatenation, Multiplication (or String Repetition), Slice a String, Other Data Types :Tuples Lists, Dictionary, Type Conversion .

UNIT-II

Decision Control Statements: Introduction to Decision Control Statements, Selection/Conditional Branching Statements: if Statement, if-else Statement, Nested if Statements, if-elif-else Statement .Basic Loop Structures/ Iterative Statements: while loop, for Loop, Selecting an appropriate loop. Nested Loops, The break Statement, The continue Statement, The pass Statement, The else Statement used with Loops.

Strings: Introduction, Concatenating, Appending, and Multiplying Strings, Strings are Immutable, String Formatting Operator, Built-in String Methods and Functions, Slice Operation, Specifying Stride While

Slicing Strings, () and chr() Functions, in and not in operators, Comparing Strings, Iterating String, The String Module, Regular Expressions, The match() Function, The search() Function, The sub() Function .

UNIT-III

Functions and Modules: Introduction, Need for Functions Function Definition, Function Call, Function Parameters, Variable Scope and Lifetime, Local and Global Variables, Using the Global Statement, Resolution of Names, The return statement, More on Defining Functions, Required Arguments, Keyword Arguments Default Arguments, Variable-length Arguments, Lambda Functions or Anonymous Functions, Recursive Functions, Greatest Common Divisor, Finding Exponents, The Fibonacci Series, Recursion vs Iteration.

Modules*:* The from…import statement, Name of Module, Making your own Modules, The dir() function, The Python Module, Modules and Namespaces, Packages in Python, Standard Library modules.

UNIT-IV

Data Structures in python: Sequence, Lists Access Values in Lists, Updating Values in Lists, Nested Lists, Cloning Lists, Basic List Operations , List Methods, List Comprehensions, Looping in Lists, Functional Programming :filter() Function, map() Function, reduce() Function

Tuple : Creating Tuple, Utility of Tuples, Accessing Values in a Tuple, Updating Tuple Deleting Elements in Tuple , Basic Tuple Operations, Tuple Assignment, Tuples for Returning Multiple Values, Nested Tuples , Checking the Index: index() method , Counting the Elements: count() Method , List Comprehension and Tuples, Variable-length Argument Tuples , The zip() Function, Advantages of Tuple over List.

Sets : Creating a Set, Comparing Sets, Mathematical Set Operations, Mutable Set Operators and Methods, Set Comprehensions Dictionaries: Creating a Dictionary, Accessing Values , Adding and Modifying an Item in a Dictionary, Modifying an Entry, Deleting Items, Sorting Items in a Dictionary, Looping over a Dictionary, Nested Dictionaries, Built-in Dictionary Functions and Methods.

UNIT-V

File Handling: Introduction, File Path, Types of Files, Opening and Closing Files, Reading and Writing Files, File Positions, Renaming and Deleting Files, Directory Methods, Methods from the os Module

Error and Exception Handling: Introduction to Errors and Exceptions , Handling Exceptions, Multiple Except Blocks, Multiple Exceptions in a Single Block, Except Block Without Exception , The else Clause, Raising Exceptions , Instantiating Exceptions, Handling Exceptions in Invoked Functions, Built-in Exceptions, user-defined expections, re-raising exceptions, The finally Block, Assertions in Python

Text Book:

1. *Reema Thareja, "Python programming using problem solving approach ", Oxford university press.*

References Books:

1. *Mark Summerfield, "Programming in Python 3:A Complete Introduction to the Python Language", 2nd*
    i. *edition, Addison- Wesley*
2. *Martin C. Brown, " PYTHON: The Complete Reference", McGraw-Hill, 2001.*
3. *E Balagurusamy, "Introduction to Computing and Problem Solving Using Python", McGrawHill*

Course Code	Course Title						Core/Elective
U21HSN02EG	Effective Technical Communication in English						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	2	-	-	-	30	70	2

Course Objectives:

To facilitate the students to learn the:

1. Features of Technical Communication.
2. Types of Professional Correspondence.
3. Techniques of Proposal and Report Writing.
4. Basics of Manual Writing.
5. Aspects of data interpretation with the help of visual aids. Course

Course Outcomes:

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

1. Handle technical communication effectively.
2. Use different types of professional correspondence.
3. Use various techniques of writing to generate proposals and reports.
4. Acquire adequate skills of manual writing.
5. Enhance their skills of information transfer using variety of visual aids.

UNIT-I

Introduction to Communication: General & Technical

- General Communication: Introduction, Process, Types, Flow/Channels of communication, Barriers to Communication
- Technical Communication: Introduction, Process, Types, Features – Accuracy, Precision, Brevity, Clarity, Format, Layout& Style, Use of Visual Aids
- Differences between General writing and Technical writing

UNIT-II

Technical Writing I- Information Transfer

- Information Transfer - Introduction & Types
- Verbal to Non – verbal
- Non-verbal to Verbal
- Visual Aids: Significance &Classification in Data Interpretation, Use of Graphic Organizers

UNIT-III

Technical Writing II -Official Correspondence

- Introduction of various types of correspondence: Format, Layout, Style & Etiquette
- Emails
- Inter Office Correspondence – Circulars, Agendas, Minutes of Meetings, Memos
- Business Letters – Sales Letters, Credit Letters, Cover letters/Job Applications, CV& Resume Writing

UNIT-IV

Technical Writing III-Report Writing

- Proposals
- Feasibility report

- Progress report
- Project report
- Drafting a Scientific Paper

UNIT-V

Technical Writing IV- Manual Writing

- Manuals – Introduction & Types
- User / Instruction manual / Owner's Guide
- Product manual

Textbooks:

1. *Raman, Meenakshi & Sharma, Sangeeta. (2015). Technical Communication: Principles and Practice (3rd ed.). New Delhi, OUP.*
2. *Rizvi, Ashraf, M.(2017). Effective Technical Communication (2nd ed.). New Delhi, Tata McGraw Hill Education.*
3. *Sharma, R.C., & Mohan, Krishna. (2017.) Business Correspondence & Report Writing: A practical approach to business & technical Communication (4th ed.). New Delhi, Tata McGraw Hill Education.*
4. *Tyagi, Kavita & Misra, Padma. (2011). Advanced Technical Communication. New Delhi, PHI Leaning.*
5. *Jungk, Dale. (2004). Applied writing for technicians. New York, McGraw-Hill Higher Education.*
6. *Munter, Mary. (2011). Guide to Managerial Communication: Effective Business Writing and Speaking. New Delhi, Pearson.*
7. *Andrea J Rutherford (2006) Basic Communication Skills for Technology, 2nd edition,Chennai, Pearson Education.*
8. *Geraldine E. Hynes,(2010), Managerial Communications-Strategies and Applications. New York, McGraw Hill*
9. *Terry O' Brien (2012) Little Red Books- Modern Writing Skills, Hyderabad, Rupa Publications*
10. *Martin Cutts (2013) Oxford Guide To Plain English, New Delhi, OUP*

Course Code	Course Title						Core/ Elective
U21MCN01PO	Indian Constitution						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	2	-	-	-	30	70	0

Course Objectives

The objectives of this course is to impart knowledge to

1. Generates the Consciousness in the students on Democratic values and Principles Articulated in the Constitution
2. Acquire knowledge about structure of Union, State and local governments
3. Aware the students about their Rights and Duties.
4. Understand the nature and character of relations between union and state governments
5. Divulge the students about the statutory institutions and policies.

Course Outcomes

After completing this course, the student will be able to:

1. Comprehensive Knowledge about the constitution of India.
2. Understand the basic provisions of the Union, State, local Governments
3. Awareness about the Fundamental rights and Directive principles of State policy
4. Capacity of the students enhanced to the level of analyzing the relations between Union and State governments.
5. Basic ideas about the functioning of statutory bodies

UNIT-I

Evolution of the Indian Constitution: 1909 Act,1919 Act,1935 Govt of India Act,Constituent Assembly: Composition and Functions, Basic structure of Indian Constitution, Fundamental features of the Indian Constitution.

UNIT-II

Rights and Duties: Fundamental Rights, Directive principles of State Policy and Fundamental Duties, Public Interest Litigation (PIL).

UNIT-III

Union Government: Legislature, Executive-President, Prime Minister,
Council of Minister Judiciary, Judicial Review and activism
State Government: Executive: Governor, Chief Minister, Council of Minister
Local Government: Panchayat Raj Institutions, Urban Governance

UNIT-IV

Union-State relations-Administrative, Inter-state council,
Legislative & Financial, Finance Commission of India, NITI Aayog.

UNIT-V

Statutory Institutions: Elections-Election Commission of India, National Human Rights Commission, National Commission for Women.

Text Books:

1. *Indian Polity by M. Laxmikanth, McGraw Hill Publications (6th Edition)*
2. *Introduction to Constitution of India by D. D. Basu, LexisNexis Publications (22nd Edition)*
3. *Politics and Ethics of the Indian Constitution by Rajeev Bhargava, Oxford Publications.*

Course Code	Course Title						Core/Electi ve
U21BSN81MT	Computational Mathematics Lab						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	25	50	1

Course Objectives

During the course the student is expected to

1. To Know the history and features of Math tools like SCI LAB/MATLAB
2. To Know the local environment of MATLAB/SCI LAB
3. To study the concept of definite integrals, differential equations and system of equations using MATLAB/SCI LAB.
4. To study the concept of Eigenvalues and Eigenvectors using MATLAB/SCI LAB.
5. To study simple mathematical functions using 2D and 3D plots.

Course Outcomes

After completing this course, the student will be able to:

1. Understand the main features of the MATLAB/SCI LAB program development environment to enable their usage in the higher learning..
2. Evaluate definite integrals using MATLAB/SCI LAB.
3. Solve linear differential equations with constant coefficients using MATLAB/SCI LAB.,
4. Solve system of linear equations using MATLAB/SCI LAB.
5. Find Eigenvalues and Eigenvectors using MATLAB/SCI LAB
6. Interpret and visualize simple mathematical functions using 2D and 3D plots

List of programs:

1. Introduction to MATLAB and GUI
2. Basic operators of MATLAB/ SCI LAB
3. Finding roots of algebraic equation.
4. Determinant of matrices.
5. Rank of a matrix
6. Solving system of linear equations using matrices.
7. Eigenvalues.
8. Eigenvectors.
9. Solution of first order linear differential equations.
10. Solution of second order linear homogeneous differential equation with constant coefficients.
11. Evaluating definite integrals
12. Data plotting for 2D and 3D

Course Code	Course Title						Core/Ele ctive
U21BSN81PH	Physics Lab						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	4	25	50	2

Course Objectives

During the course the student is expected to

1. To analyze a Semiconducting device and determine its temperature Coefficient of Resistance, Energy Gap, Electrical Conductivity, Mobility, concentration of charge carriers and its efficiency.
2. To determine the wavelength of given laser source, Sodium vapour lamp by using diffraction grating.
3. To explain the principle of Optical Fiber and determine its Numerical Aperture, Acceptance Angle and losses.
4. To demonstrate Torsional Pendulum, LCR Series and Parallel Circuit and calculate Rigidity Modulus of a given wire and frequency of LCR Series and Parallel Circuit.
5. To examine the nature of Ferro Magnetic Materials, Dielelctric Materials and Calculate their related parameter
6. To explain Seebeck Effect and Determine Seebeck Coefficient of thermoelectric device.

Course Outcomes

After completing this course, the student will be able to:

1. Analyze a Semiconducting device and determine its temperature Coefficient of Resistance, Energy Gap, Electrical Conductivity, Mobility, Concentration of charge carriers and efficiency.
2. Determine the Wavelength of Laser source, Sodium Vapour lamp using diffraction grating.
3. Explain the principle of Optical Fiber and determine its Numerical Aperture, Acceptance angle and losses.
4. Demonstrate Torsional Pendulum, LCR series and Parallel circuit and calculate the Rigidity Modulus of given metallic wire, resonant frequency of LCR Series & Parallel circuit.
5. Examine the nature of ferromagnetic materials, dielectric materials and calculate their related parameter
6. Explain Seebeck Effect and determine Seebeck Coefficient of thermoelectric device

List of experiments:

1. To Determine the Numerical aperture (NA), Acceptance Angle of the Optical Fiber, and To study the various losses of that occur in optical fiber.
2. To determine the wave[redacted]gth ( ) of the given Laser source.
3. To determine V-I characteristics of the given LED.
4. To draw the V-I characteristics of a Solar Cell and calculate the Fill Factor and Series Resistance.

5. To draw the I - V Characteristics of P-N Junction diode and to evaluate the resistance for forward bias and reverse bias.
6. To determine the constants of A, B and α using Thermistor characteristics.
7. To find the values of Electrical conductivity and energy gap of Ge crystal.
8. To determine the wave length of radiation emitted by Sodium vapour lamp using Diffraction Grating.
9. To study the behavior of Series LCR Resonant circuit and to estimate the resonant frequency and Q factor.
10. To study the variation in currant and voltage in parallel LCR Circuit and to find the resonant frequency of parallel LCR Circuit.
11. Determination of rigidity of modulus of Torsional pendulum.
12. To determine the Dielectric constant of the given Dielectric samples.
13. To draw the curve between the magnetizing field and the intensity of magnetization of the specimen (soft iron rod) and to find out i) Coercivity ii) Retentivity and iii) Hysteresis loss.
14. To calculate Seebeck Coefficient of the given sample.
15. To determine the Hall coefficient, Carrier concentration and mobility of charge carriers of semi conducting material.
16. To determine the velocity of the Ultrasonic Waves.

Course code	Course Title						Core/Elective
U22ESN82CS	Problem Solving using Python Programming Lab						Core
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	25	50	1

Course Objectives:

The objectives of this course is to impart knowledge of

1. Enabling students to learn basic fundamentals of python
2. To improve logical skills by working with control statements, mathematical functions
3. To learn about modular programming through functions and recursive programs
4. To handle logical, syntax errors and define custom errors as per real world problems
5. Enabling students to learn python built-in modules

Course Outcomes:

After completing this course, the student will be able to:

1. Implement basic syntax, semantics in python and improve logical skills
2. Formulate mathematical computations, store data using strings, collection types
3. Perform modular programming using functions and recursion
4. Handle and define multiple exceptions logically, syntactically and also able to access files
5. Implement built-in modules in various domains like big data, machine learning

List of Experiments

1. Demonstrate the following Operators in Python with suitable examples. i) Arithmetic Operators ii) Relational Operators iii) Assignment Operator iv) Logical Operators v) Bit wise Operators vi) Ternary Operator vii) Membership Operators viii) Identity Operators
2. Company decides to give bonus to all its employees on Diwali. a 5% bonus on salary is given to the male workers and 10% bonus on salary to the female workers. Write a program to enter the salary and gender of the employee. If the salary of the employee is less than Rs..10000, then the employee gets an extra 2% bonus on salary. Calculate the bonus that has to be given to the employee and display the salary that the employee will get.
3. Write a program to calculate roots of quadratic equation.
4. Write a program to enter a decimal number. Calculate and display the binary equivalent of this number.
5. Read x, y and print all prime numbers between x and y where x<=y.
6. Write a program to check whether the given number is an “amicable” numbers/ Armstrong number/Strong

number.

7. Write a program using for loop to calculate the value of an investment. Input an initial value of investment and annual interest and calculate the value of investment over time.
8. a) Demonstrate the different ways of creating list objects with suitable example programs.

   b) Demonstrate the following functions/methods which operates on lists in Python with suitable examples: i) list( ) ii) len() iii) count( ) iv) index ( ) v) append( ) vi) insert( ) vii) extend() viii) remove( ) ix) pop( ) x) reverse( ) xi) sort( ) xii) copy() xiii) clear( )

   c) Demonstrate the following with suitable example programs: List slicing
9. a) Demonstrate the different ways of creating tuple objects with suitable example programs.

   b) Demonstrate the following functions/methods which operates on tuples in Python with suitable examples: i) len( ) ii) count( ) iii) index( ) iv) sorted( ) v) min ( ) vi) max( ) vii) cmp( ) viii) reversed( )
10. a) Demonstrate the different ways of creating set objects with suitable example programs.

    b) Demonstrate the following functions/methods which operates on sets in Python with suitable examples: i) add( ) ii) update( ) iii) copy( ) iv) pop( ) v) remove( ) vi) discard( ) vii) clear( ) viii) union() ix) intersection( ) x) difference( )
11. a) Demonstrate the different ways of creating dictionary objects with suitable example programs.

    b) Demonstrate the following functions/methods which operates on dictionary in Python with suitable examples: i) dict( )

    ii) len( ) iii) clear( ) iv) get( ) v) pop( ) vi)popitem( ) vii) keys( ) viii) values() ix) items( ) x) copy( ) xi) update( )
12. a) Write a Python program to demonstrate various ways of accessing the string. i) By using Indexing (Both Positive and Negative) ii) By using Slice Operator

    b) Demonstrate the following functions/methods which operates on strings in Python with suitable examples: i) len( ) ii) strip( ) iii) rstrip( ) iv) lstrip( ) v) find( ) vi) rfind( ) vii) index( ) viii) rindex()ix) count( ) x) replace( ) xi) split( ) xii) join( ) xiii) upper( ) xiv) lower( ) xv) swapcase( ) xvi) title( ) xvii) capitalize( ) xviii) startswith() xix) endswith()
13. Write a program that counts the occurrences of a character in a string. Do not use built-in count functions.
14. Write a program that creates a list of 10 random integers. Then create two lists – Odd List and Even List that has all odd and even values in the list respectively.
15. Write a program that generates a set of prime numbers and another set of odd numbers. Demonstrate the result of union, intersection, difference, and symmetric difference operations on these sets.
16. Write a program that creates a dictionary of radius of a circle and its circumference
17. Compute a Polynomial Equation given that the Coefficients of the Polynomial are stored in a List.
18. Search the Number of Times a Particular Number Occurs in a List.
19. Read a List of Words and Return the Length of the Longest One.
20. Remove the ith Occurrence of the Given Word in a List where Words can repeat .

21. Count the number of alphabets, consonants, vowels, digits, special characters in a sentence .
22. Store some elements in the dictionary and remove a given key from the dictionary.
23. To display which Letters are in the First String but not in the Second.
24. Write a function to compute gcd, factorial, Fibonacci series.
25. Write a recursive function to compute gcd, factorial, and Fibonacci series.
26. Demonstrate on predefined multiple exceptions.
27. Demonstrate on custom exceptions.
28. Read the Contents of a File in Reverse Order.
29. Read .csv file to print the statistical summary of each attribute and visualize the data.
30. Write a Numpy program to compute sum of all elements, sum of each column and sum of each row of a given array.

Text Book:

1. *Reema Thareja, "Python programming using problem solving approach ", Oxford university press.*

Reference Books:

1. *Mark Summerfield, "Programming in Python 3:A Complete Introduction to the Python Language",2nd edition, Addison- Wesley*
2. *Martin C. Brown," PYTHON: The Complete Reference", McGraw-Hill, 2001.*
3. *E Balagurusamy,"Introduction to Computing and Problem Solving Using Python", McGrawHill*

Course Code	Course Title						Core/Elective
U21ESN82CE	Engineering Drawing Practice						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	2	-	25	50	1

Course Objectives

The objectives of this course is to impart knowledge

1. To make students communicate effectively through a common drawing language and understand any engineering drawing
2. To prepare the students to use techniques, skills and modern engineering tools necessary for engineering practice
3. To prepare students to design a system, component and any desired requirement through computer drafting
4. To enhance the imaginative skills of a student and thereby making them creative

Course Outcomes

After completing this course, students will be able to:

1. Understand engineering drawing and its place in society
2. Expose virtual aspects of engineering drawing practice
3. Recognize modern technical tools of engineering drawing like AUTOCAD and apply in different fields of engineering
4. Think creatively in getting alternative options to practical problems to engineering
5. Communicate technical aspects through engineering drawing

Sheet No	Description of the Topic	Contact Hours Drawing
1	**Introduction to Engineering Drawing** - Principles of Engineering Drawing andtheir Significance ***Introduction to AutoCAD*** **-** Basic commands and simple drawings	**2**
2	**Construction of Scales -** Types of scales and Construction of plain scale	2
3	***Conic Sections*** **-** Construction of ellipse, parabola and hyperbola by general methodand any special method	**2+2**
4	**Concept of Quadrant System -** Understand the quadrant system with the help ofpoints and lines	**2+2**
5	**Projection of Planes -** Simple positions and plane inclined to single plane	**2+2**
6	**Projection of Solids -** Simple positions and plane inclined to single plane	**2+2**
7	**Isometric Drawing -** Simple planes and solids in isometric views (Combination ofSolids)	**2+2**
8	**Orthographic Projections -** Conversion of geometric figures and drawings fromisometric view to orthographic view	**2+2**

Text Books:

1. *N.D. Bhatt, V. M Panchal & P. R. Ingle , "Engineering Drawing", Charotar Publishing House, 2014*
2. *M. B. Shah, & B. C. Rana , "Engineering Drawing and Computer Graphics", Pearson Education, 2008*
3. *S. N. Lal, "Engineering Drawing with Introduction to Auto CAD", Cengage Learning India Pvt Lid, New Delhi, 2018.*
4. *Agrawal & C. M. Agrawal, "Engineering Graphics", TMH Publication, 2012*
5. *K. L. Narayana, & P Kannaiah, "Text book on Engineering Drawing", Scitech Publishers, 2008*
6. *(Corresponding set of) CAD Software Theory and User Manuals*

NOTE:

1. *At least 6 sheets must be drawn.*
2. *Sheet number 1 to 3 (Graph sheets / drawing sheets)*
3. *Sheet number 4 to 8 (AutoCAD drawings)*

R21-BE CSE (IoT-CS-BcT) SEMESTER-III

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/ Drg	Contact Hrs/ week	CIE	SEE	Duration of SEE (Hrs.)	
Theory Courses										
1	U21ES301CS	Logic and Switching Theory	3	-	-	3	30	70	3	3
2	U21PC301CS	Database Management Systems	3	-	-	3	30	70	3	3
3	U21PC304CS	Data Structures and Algorithms Using 'C'	3	-	-	3	30	70	3	3
4	U21PC303CS	Discrete Mathematics	2	1	-	3	30	70	3	3
5	U21BSN03MT	Engineering Mathematics – III	3	-	-	3	30	70	3	3
6	U21MCN01CE	Environmental Science	2	-	-	2	30	70	3	-
7	U21HSN01CO	Finance and Accounting	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
7	U21PC381CS	Database Management Systems Lab	-	-	2	2	25	50	3	1
8	U21PC384CS	Data Structures and Algorithms Using 'C' Lab	-	-	4	4	25	50	3	2
		Total	**19**	**1**	**6**	**26**	**260**	**590**	**-**	**21**

Course Code	Course Title						Core/ Elective
U21ES301CS	Logic and Switching Theory						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Boolean Algebra	3	-	-	-	30	70	3

Course Objectives:

1. Discuss number systems, conversions, Complement arithmetic, Boolean algebra and logic gates.
2. Minimization of logic functions using K-map and Tabular method.
3. Discuss about design and analysis of combinational logic circuits.
4. Discuss about design and analysis of Sequential logic circuits.
5. Explain various Programmable Logic Devices.

Course Outcome:

Upon completion of the course, student will be able to

1. Manipulate numeric information in different forms
2. Minimize Boolean expressions using the theorems , Map and Tabular methods
3. Design and analyse combinational circuits
4. Design and analyse sequential circuits
5. Design PLD

UNIT-I

Number System and Boolean Algebra: Number Systems Decimal, Binary, Octal, Hexa-decimal, Base Conversion Methods, Complements of Numbers, Signed Binary Numbers, Codes- Binary Codes, Binary Coded Decimal Code (BCD) Unit Distance Codes, Parity Codes. Basic Logic Gates (AND, NAND, OR, NOR, EX- OR, EX-NOR), Properties of XOR Gates, Universal Gates, Basic Theorems and Properties of Boolean algebra, Boolean Functions, Canonical and Standard Forms, Min-terms and Max-terms,

UNIT-II

Minimization Techniques: Introduction, The minimization with theorems , The Karnaugh Map Method, Three, Four and Five variable K- Maps, Prime and Essential Implications, Don't Care Map Entries, Using the Maps for Simplifying, Quine-McCluskey Method, Don't Care entries , AND-OR, OR-AND and NAND/NOR Realizations, Exclusive-OR and Equivalence Functions.

UNIT-III

Combinational Circuits: Design with basic logic gates, Single Output and Multiple Output Combinational Logic Circuit Design, Analysis of combinational circuits, Design Procedure – Half Adder, Full Adder, Half Subtractor, Full Subtractor, Parallel Binary Adder, Parallel binary subtractor, Binary Multiplier, Multiplexers, De-Multiplexers, decoder, Encoder, Code Converters, Magnitude Comparator.

UNIT-IV

Sequential Circuits: Introduction, Memory element, S-R, J-K and D Latch operation, Race around condition, Master Slave J-K Flip Flop, Flip-Flop types: S-R, J-K, D, T, State table, State diagram, Characteristic equation and excitation table, Flip flop conversions, Analysis of sequential circuits.

Sequential Logic Design: Design of sequential circuits, Counters - Asynchronous and Synchronous, Registers.

UNIT-V

Programmable Logic Devices (PLDs): General structure of a Programmable Array Logic (PAL), Programmable Logic Arrays (PLAs), Programmable Read only Memory (PROM), Structure of CPLDs and FPGAs, 2-input and 3-input lookup tables (LUT).

Finite State machine (FSM) representation using Moore and Mealy state models - Sequence Detector.

Text Books:

1. *Digital Design- Morris Mano, PHI, 3rd Edition.*
2. *Switching Theory and Logic Design- A. Anand Kumar, PHI, 2nd Edition.*
3. *Switching and Finite Automata Theory- Zvi Kohavi & Niraj K. Jha, 3rd Edition, Cambridge.*

Reference Books:

1. *Ronald J.Tocci, Neal S. Widmer &Gregory L.Moss, "Digital Systems: Principles and Applications," PHI, 10/e, 2009.*
2. *Digital Fundamentals – A Systems Approach – Thomas L. Floyd, Pearson, 2013.*
3. *Fundamentals of Logic Design- Charles H. Roth, Cengage LEanring, 5th, Edition, 2004.*
4. *Digital Logic Applications and Design- John M. Yarbrough, Thomson Publications, 2006.*
5. *Digital Logic and State Machine Design – Comer, 3rd, Oxford, 2013.*

e-Resources:

1. *Switching Circuits and Logic Design By Prof. Indranil Sengupta, IIT Kharagpur - https://archive.nptel.ac.in/courses/106/105/106105185/*

Course Code	Course Title						Core/ Elective
U21PC301CS	Database Management Systems						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
PPS using C, Data Structures	3	-	-	-	30	70	3

Course Objectives:

1. To Learn mathematical concepts as applied in computer.
2. To introduce three scheme architecture and DBMS functional components.
3. To learn formal and commercial query languages of RDBMS.
4. To Study different file organization and indexing techniques.
5. To familiarize theory of serializablity and implementation of concurrency control, and recovery.

Course Outcomes:

1. Understand the mathematical foundations on which RDBMS are built.
2. Model a set of requirements using the Extended Entity Relationship Model. (EER), transform an EER model into a relational model and refine the relational model using theory of normalization.
3. Use the knowledge of file organization and indexing to improve database application performance.
4. Understand the working of concurrency control and recovery mechanisms in RDBMS.
5. Compare and contrast RDBMS with NoSQL databases.

UNIT-I

Introduction: Database System Application, Purpose of Database Systems, View of Data, Database Language, Relational Databases, Database Design, Object-Based and Semi-Structured Databases, Data Storages and Querying , Transaction Management, Data Mining and Analysis, Database Architecture, Database Users and Administrators.

Database Design and the E-R Model: Overview of the Design Process, The Entity Relationship Model Constraints, Entity-Relationship Design issues, Weak Entity Sets Extended E-R Features Database Design for banking Enterprise, Reduction to Relational Schemas, Other Aspects of Database Design

UNIT-II

Relational Model: Structure of Relational Databases, Fundamental Relational-Algebra Operations, Additional Relational-Algebra Operations, Extended Relational-Algebra Operations, Null Values, Modification of the Databases.

Relational Database Design: Features of Good Relational Design, Atomic Domains and First Normal Form, Functional Dependency Theory, Decomposition using Functional Dependencies.

UNIT-III

Indexing and Hashing: Basic Concepts, Ordered Indices, B+-tree index files, B-tree index files, multiple key access, static hashing, dynamic hashing, comparison of ordered indexing and hashing bitmap indices.

UNIT-IV

Transactions: Transaction concepts, transaction state, implementation of atomicity and durability, concurrent executions, serializability, recoverability, implementation of isolation, testing for serializability.

Concurrency Control: Lock based protocols, timestamp based protocols, validation based protocols, multiple granularity, multi version schemes, deadlock handling, insert and delete operations, weak levels of consistency, concurrency of index structures.

UNIT-V

Recovery system: Failure classification, storage structure, recovery and atomicity, log-based recovery, recovery with concurrent transactions, buffer management, failure with loss of non-volatile storage, advanced recovery techniques, remote backup systems.

Introduction, Overview, and History of NoSQL Databases – The Definition of the Four Types of NoSQL Databases. Comparison of relational databases to NoSQL

Text Books:

1. *Abraham Silberschatz, Henry F Korth, S Sudarshan, Database System Concepts, McGraw-Hill, 6th Edition, 2010*
2. *Ramakrishnan, Gehrke, Database Management Systems, McGraw-Hill, 3rd Edition, 2003*

Reference Books:

1. *Elmasri, Navathe, Somayajulu, Fundamentals of Database Systems, Pearson Education, 4th Edition, 2004.*
2. *Sadalage, P. & Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Wiley Publications,1st Edition ,2019.*

e-Resources:

1. *Data Base Management System By Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay, IIT Kharagpur - https://archive.nptel.ac.in/courses/106/105/106105175/*
2. *Oracle Academy, Database Programming with SQL and PL/SQL offered by MVSREC - https://academy.oracle.com/en/solutions-curriculum-database.html*

Course Code	Course Title						Core/Elective
U21PC304CS	Data Structures and Algorithms Using 'C'						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Programming & problem solving using C	3	-	-	-	30	70	3

Course Objectives

To teach efficient storage mechanisms of data for an easy access.

1. To design and implement of various basic and advanced data structures.
2. To solve real world problems with the help of fundamental data structures
3. To understand concepts about searching and sorting techniques
4. To Understand basic concepts about Linear and Non-linear data structures
5. To comprehend the importance of Graphs, Trees and hashing techniques

Course Outcomes

After completing this course, the student will be able to:

1. Implement and manipulate advanced data types and structures in C, including structures and unions.
2. Utilize stacks and queues in C, implementing their operations and solving practical problems.
3. Manage and apply operations on linked lists (singly, circular, and doubly) for efficient data handling.
4. Understand and perform operations on trees, including binary and AVL trees, for optimized data access.
5. Master graph representation and traversal, and apply efficient searching and sorting techniques.

UNIT-I

Enumerated, Structure ,and Union Types in C – The Type Definition (typedef), Enumerated types, Structures – Declaration, initialization, accessing structures, operations on structures, Complex structures, structures and functions, Passing structures through pointers, self-referential structures, unions, bit fields, C programming examples. Data Structures – Introduction to Data Structures, abstract data types. Definition of Linear and Non- linear data structures.

UNIT-II

Stacks: Definition, operations, array implementation in C. Stack Applications: Factorial Calculation, Infix to postfix Transformation, Evaluating Arithmetic Expressions.

Queues: **Definition and operations, array implementation in C, Deque (Double ended queue)** Circular Queues, Applications of Queues.

UNIT-III

Linear list – Singly linked list implementation, insertion, deletion and searching operations on linearlist, Circular Singly linked lists- Operations on Circularly Singly linked lists, Doubly linked list implementation, insertion, deletion and searching operations, applications of linked lists. Stacks and Queues implementation using linked list.

UNIT-IV

Trees – Definitions, tree representation, applications of trees , Binary tree representation, binary tree

properties, binary tree traversals, Operations on Binary Trees(clone, delete, Mirror), Heaps, Binary search tree, Operations.

Balanced Search Trees: AVL tree Operations

UNIT-V

Graphs: Basic concepts, Representations of Graphs: using Linked list and adjacency matrix, Graph algorithms. Graph Traversals (BFS & DFS)

Searching Techniques: List Searches using Linear Search, Binary Search

Sorting Techniques: Basic concepts, insertion sort, heap sort, Selection sort **Hashing**- Collision Resolution Techniques

Text Books:

1. *Fundamentals of Data structures in C, 2nd Edition, E.Horowitz, S.Sahni and Susan AndersonFreed, Universities Press.*
2. *Data Structures using C. ReemaThareja , Oxford*
3. *Data Structures, 2/e, Richard F, Gilberg , Forouzan, Cengage*

Reference Books:

1. *Data structures and Algorithm Analysis in C, 2nd edition, M.A.Weiss, Pearson.*
2. *Data Structures using C, A.M.Tanenbaum, Y. Langsam, M.J.Augenstein, Pearson.*
3. *Data structures and Program Design in C, 2nd edition, R.Kruse, C.L.Tondo and B.Leung,Pearson*
4. *Data structures A Programming Approach with C, D.S.Kushwaha and A.K.Misra, PHI.*
5. *Data Structure with C, Seymour Lipschutz, TMH*

e-Resources:

1. *Data Structures And Algorithms, IIT Delhi, Prof. Naveen Garg - https://nptel.ac.in/courses/106102064*

Course Code	Course Title						Core/ Elective
U21PC303CS	Discrete Mathematics						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Engineering Mathematics	2	1	-	-	30	70	3

Course Objectives:

1. To learn logical notations to define and reason about fundamental mathematical concepts such as sets, relations, functions and Induction.
2. To model relationships, analyze data, apply probability concepts and use functions to solve problems.
3. Understand random and discrete variables.
4. To formulate problems and solve generating functions and recurrence relations
5. To model and solve problems using graphs and trees.

Course Outcomes:

After completing this course, the student will be able to:

1. Apply Propositional and Predicate logic for a variety of problems in various domains.
2. To distinguish random and discrete variables and compute expected value and variance.
3. Formulate recurrence relations for a sequence and solve first order and second order recurrence relations by finding the corresponding generating functions.
4. To understand the properties implied by the definitions of algebraic system and demonstrate examples of groups, subgroups, homomorphism.
5. Develop the given problem as a graph network and solve with the techniques of graph theory.

UNIT-I

Logic and Set theory – Logic, Propositional equivalences – Predicates and quantifiers – Nested Quantifiers-Sets-Set Operations, Venn diagrams.

Mathematical Reasoning- Mathematical Induction, Recursive Definitions. The Fundamental Theorem of Arithmetic.

Relations and Functions: Relations & their Properties, Representing relations – Closures, equivalence relations, partial orderings, Types of functions-bijective, inverse and composite functions.

UNIT-II

Counting Techniques: Principle of Inclusion and Exclusion, Pigeonhole principle, Binomial coefficients, Permutations and Combinations, Derangements.

Discrete Probability: An Introduction to Discrete Probability theory, Expected Value and Variance.

UNIT-III

Generating Functions: Introduction, Definitions and examples, Exponential Generating function.

Recurrence relations – Solving First-order and second order linear Recurrence Relations, Recurrence relations with constant coefficients, Divide and conquer relations.

UNIT-IV

Algebraic Structures: Algebraic System, Properties, Semi-groups, groups, monoids, homomorphism, isomorphism, Group codes and their applications.

UNIT-V

Graph Theory: Graphs and their Properties, Degree, Connectivity, Path, Cycle, Isomorphism, Hamiltonian graphs, Euler and Planar graphs, Graph coloring, Chromatic number.

Trees: Definitions, Properties and Examples, Rooted Trees, Spanning Trees, Minimum Spanning Trees.

Text Books:

1. Kenneth H. Rosen – Discrete Mathematics and its Application – 5th Edition, McGraw Hill, 2003
2. Joel. Mott. Abraham Kandel, T.P. Baker, Discrete Mathematics for Computer Scientist & Mathematicians, Prentice Hail N.J., 2nd Edition, 1986.

Reference Books:

1. Ralph P. Grimaldi, B. V. Ramana -Discrete and Combinatorial Mathematics: An Applied Introduction-5th Edition.
2. J.P. Tremblay, R. Manohar, Discrete Mathematical Structure with Application to Computer Science, McGraw Hill – 1997.
3. J. K. Sharma, Discrete Mathematics, Second Edition, Macmillan, 2005.

e-Resources:

1. Discrete Mathematics, IIT Ropar, Dr. Anil Shukla, Prof. Sudarshan Iyengar - https://nptel.ac.in/courses/106106183

Course Code	Course Title						Core/Elective
U21BSN03MT	Engineering Mathematics-III (Common to All Branches)						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
EM - I & II	3	-	-	-	30	70	3

Course Objectives:

1. To introduce the basic concepts of probability
2. To study the concepts of discrete and continuous probability distributions
3. To introduce and study the concepts of fitting of curves, Correlation and Regression
4. To study the concepts of testing of hypothesis for small samples
5. To comprehend the importance of T-test, F-test and Chi-square test.

Course Outcomes:

1. Solve the problems by using the concepts of probability and random variables.
2. Determine the statistical parameters for discrete probability distributions.
3. Determine the statistical parameters for continuous probability distributions.
4. Solve problems on curve fitting, correlation and lines of regression.
5. Test the hypothesis for small samples.

UNIT-I

Probability: Introduction to Probability, Conditional Probability, Theorem of Total probability, Bayes Theorem and its applications, Random variables, Types of random variables, Probability mass function and Probability density function, Mathematical expectation, variance. (12 hours)

UNIT-II

Discrete probability distributions: Introduction to Binomial and Poisson distributions, evaluation of statistical parameters -mean, variance, moment generating function, moments, skewness and kurtosis by central moments. (9 hours)

UNIT-III

Continuous probability distributions: Introduction to Uniform, Normal distributions, evaluation of statistical parameters - mean, variance, moment generating function, moments, skewness and kurtosis by central moments, Central limit theorem (without proof) (9 hours)

UNIT-IV

Correlation and Regression: Fitting of straight-line, second-degree Parabola and Power curves. Correlation, Regression and Rank correlation. (11 hours)

UNIT-V

Tests of significance: Small Samples-Introduction, Test of Hypothesis, t-test for single mean, difference of means, F-test for ratio of variances, Chi-square test for goodness of fit. (11 hours)

Text Books:

1. *R. K. Jain & S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publications.*
2. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publications.*
3. *S.C. Gupta & V. K. Kapoor, "Fundamentals of Mathematical Statistics", S. Chand Pub.*

Reference Books:

1. *N. P. Bali, &M. Goyal, "A text book of Engineering Mathematics", Laxmi publications, 2010.*
2. *P. G. Hoel, S. C. Port & C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003.*
3. *W. Feller, "An Introduction to Probability Theory and its Applications", Vol. I, Wiley, 1968.*

e-Resources:

1. *Introduction to probability theory and stochastic processes, PROF. S. DHARMARAJA, Department of Mathematics, IIT Delhi - https://archive.nptel.ac.in/courses/111/102/111102111/*

Course Code	Course Title						Core/Elective
U21MCN01CE	Environmental Science						Mandatory
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Engg. Chemistry	2	-	-	-	30	70	0

Course Objectives:

1. To create awareness and impart basic knowledge about the environment and its allied problems.
2. To know the significance and functions of ecosystem.
3. To understand importance of biological diversity.
4. To study different forms of pollution and their impact on environment.
5. To know social and environment related issues and their preventive measures.

Course Outcomes:

After completing this course, students will be able to:

1. Develop an attitude of concern towards the environment.
2. Understand the importance of ecosystem.
3. Conservation of natural resources and biological diversity.
4. Develop knowledge on Environmental pollution and Environmental loss
5. Adopt environmental ethics to attain sustainable development

UNIT -I

The Multidisciplinary Nature of Environmental Studies: Definition, scope and importance, need for public awareness.

Natural Resources: Water Resources – Use and over utilization of surface and ground water, flood, drought, conflicts over water, Dams: Benefits and Problems. Food Resources–World Food Problems, effects of modern agriculture, fertilizer-pesticides problems, waterlogging, salinity, Forest Resources – Use and over exploitation, deforestation & its effect on tribal people. Land Resources–Land Degradation, soil erosion and desertification. Energy Resources –Growing energy needs, Renewable and Non-renewable energy resources.

UNIT -II

Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in ecosystem, food chains, ecological pyramids, ecological succession, types of ecosystems (marine, pond, river, forest, grassland, desert)

UNIT -III

Biodiversity: Levels of Biodiversity, Bio-geographical classification of India, Value of biodiversity, Threatsto biodiversity, endangered and endemic species of India, Conservation of biodiversity.

UNIT -IV

Environmental Pollution: Definition, Causes, effects and control measures of air pollution, water pollution,Soil pollution, noise pollution, thermal pollution, solid waste management

Environment Protection Act: Air, water, forest and wildlife Acts, issues in the enforcement of environmental legislation.

UNIT -V

Social Issues and the Environment: Watershed management and environmental ethics. Climate change, global warming, acid rain, ozone layer depletion.

Environmental Disaster Management: Types of disasters, impact of disasters on environment, infrastructure, and development. Disaster management cycle and disaster management in India.

Text Books:

1. *A.K.De, Environmental Chemistry, Wiley Eastern Ltd., 2016.*
2. *E.P.Odum, Fundamentals of Ecology, W.B. Sunders Co., USA, 2017*
3. *M.N. Rao and A.K.Datta, Waste Water Treatment, Oxford and IBK Publications, 2020*
4. *Benny Joseph, Environmental Studies, Tata McGraw Hill, 2005.*

Reference Books:

1. *V.K.Sharma, Disaster Management, National Centre for Disaster Management, IIPE,1999.*
2. *Benny Joseph, Environmental Studies, 3 rd Edition ,Tata McGraw Hill, 2017, ISBN-13 978-935260517*
3. *V.K.Sharma, Disaster Management, 2 nd Edition,Medtech Publisher,2023,ISBN No: 978 9381714317*

e-Resources:

1. *Introduction to Environmental Engineering and Science - Fundamental and Sustainability Concepts, IIT Kharagpur*
2. *Prof. Brajesh Kumar Dubey - https://nptel.ac.in/courses/127105018*

Course Code	Course Title						Core/ Elective
U21HSN01CO	Finance and Accounting						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
EM – I & II	3	-	-	-	30	70	3

Course Objectives:

The course will introduce the students to

1. To provide understanding of the accounting aspects of business.
2. To provide understanding of financial statements.
3. To provide understanding of financial system.
4. To provide inputs necessary to evaluate the viability of projects.
5. To provide the skills necessary to analyse the financial statements.

Course Outcomes:

After successful completion of the course the students will be able to

1. Evaluate the financial performance of the business unit.
2. Assess on selection of projects.
3. Take decisions on procurement of finances.
4. Analyse the liquidity, solvency and profitability of the business unit.
5. Understand the functionalities of various financial instituions and ombudsmans

UNIT-I

Basics of Accounting: Financial Accounting-Definition - Accounting Cycle –Journal - Ledger - Cash Book – Bank Reconciliation Statement and Trial Balance (including problems)

UNIT-II

Final Accounts: Trading Account - Profit and Loss Account - Balance Sheet (including problems with adjustments like Closing Stock, Expenses Outstanding, Prepaid Expenses, Income earned but not received, Income received in advance, Depreciation, Bad debts, Provision for Bad and Doubtful Debts, Provision for Discount on Debtors, Provision for Discount on Creditors, Interest on Capital, Interest on Drawings)

UNIT-III

Financial Statement Analysis: Importance-Users - Ratio Analysis - Liquidity, Solvency, Turnover & Profitability Ratios.

UNIT-IV

Capital Budgeting: Meaning – Importance - Time Value of Money- Discounting - Compounding - Financial Appraisal of Project – Payback Period, ARR, NPV, PI, IRR (Simple problems)

UNIT-V

Financial System and Markets: Financial System - Financial Markets – Financial Institutions – Financial Instruments – Financial Intermediaries – RBI, SEBI and IRDA (Functions only)

Text Books:

1. *Accountancy – I: Haneef & Mukarjee, Tata McGrahill Company*
2. *Financial Management – I.M. Pandey, Vikas Publishers*
3. *Financial Institutions & Markets – Prashanta Athma, PBP*

Reference Books:

1. *Accountancy – I: SP. Jain & KL. Narang, Kalyani Publishers*
2. *Advanced Accountancy – I: S.N. Maheshwari & V.L. Maheswari, Vikas Publishers*

e-Resources:

1. *Financial Accounting, By Prof. Puran Singh, IIT Mandi, https://archive.nptel.ac.in/courses/110/106/110106147/*

Course Code	Course Title						Core/ Elective
U21PC381CS	Database Management Systems Lab						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
PPS using C, Data Structures	-	-	-	2	25	50	1

Course Objectives:

1. To identify entities and keys in E-R models from case studies.
2. Convert E-R models into relational models for database design.
3. To practice various DDL commands in SQL
4. To write simple and complex queries in SQL
5. To familiarize PL/SQL

Course Outcomes:

1. Design ER and relational model for the given problem-domain
2. Declare and enforce integrity constraints on a database
3. Query a database using SQL DML / DDL
4. Implement procedures, Cursors and Triggers.
5. Familiarity with NoSQL Database using MangoDB

Week 1: E-R Model
Identifying Entities, attributes with different types of keys for a given case study.

Week 2: Conceptual design with E-R Model
Identify relationships appropriately and apply cardinalities for each relationship. Identify strong entities and weak entities (if any). Indicate the type of relationships (total / partial).

Week 3: Relational Model
Reduce E-R model designed in Week-2 into Relational model.

Week 4: Normalization
Apply Normalization concepts on the tables designed in week-3 so as to remove various anomalies.

Week 5: Installation of MySQL and practicing DDL commands

Week 6: Practicing DML commands

Week-7: Usage of Aggregate functions with group by and having.

Week 8: Querying: Usage of set operators and Creation and dropping of Views.

Week 9: PL/SQL: Implementing Procedures

Week 10: PL/SQL: Implementing Triggers

Week 11: PL/SQL: Implementing Cursors

Week 12: NoSQL CRUD operations with MongoDB

Suggested Tools: *https://erdplus.com/, MySQL Community Server, MySQL Workbench, Libre Base, MongoDB*

Course Code	Course Title						Core/ Elective
U21PC384CS	Data Structures and Algorithms Using 'C' Lab						Core
Prerequisite	Contact hours per Week				CIE	SEE	Credits
	L	T	D	P			
PPS using C	-	-	-	4	25	50	2

Course Objectives:

1. Design and construct simple programs by using the concept of structures as abstract data type.
2. To have a broad idea about how to use pointers in the implement of data structures.
3. To enhance programming skills while improving their practical knowledge in data structures.
4. To understand difference between linear and non-linear data structures
5. To strengthen the ability to apply the suitable data structures for real world problems.

Course Outcomes:

After completing this course, the student will be able to:

1. Implement various data structures using arrays, linked lists
2. Develop ADT necessary for solving problems based on Stacks and Queues
3. Implement binary trees, general tree structures, advanced search trees, heaps, graphs.
4. Implement hash functions and handle collisions
5. Implement various kinds of sorting techniques and apply appropriate techniques for solving a given problem

Implement the following using C <u>Linear data structures</u>:

1. Stack using dynamic arrays
2. Infix to Postfix conversion
3. Evaluation of Postfix expression
4. Circular queue using arrays
5. Singly linked list operations
6. Doubly linked list operations
7. Stack using linked list
8. Queue Using Linked List
9. Insertion sort
10. Heap sort
11. Linear search
12. Binary search
13. Hashing

<u>Non-linear data structures</u>

14. Binary tree traversals
15. Binary search tree operations
16. Graph traversal techniques

Suggested Tools: *Dev C++, GNU C compiler*

**For e-resource refer the theory syllabus*

R21-BE CSE (IoT-CS-BcT) SEMESTER-IV

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/Drg	Contact Hrs/ week	CIE	SEE	Duration of SEE (Hrs.)	
Theory Courses										
1	U21PCN01CS	Object Oriented Programming using Java	3	-	-	3	30	70	3	3
2	U22PC401CB	Computer Organization and Assembly Language Programming	3	-	-	3	30	70	3	3
3	U22PC402CB	Internet of Things & Applications	3	-	-	3	30	70	3	3
4	U21PC401CS	Design and Analysis of Algorithms	3	-	-	3	30	70	3	3
5	U21PCN06CS	Computer Networks	3	-	-	3	30	70	3	3
6	U21MCN01PY	Essence of Indian Traditional Knowledge	2	-	-	2	30	70	3	-
Practical/ Laboratory Courses										
7	U21PCN81CS	Object Oriented Programming using Java Lab	-	-	4	4	25	50	3	2
8	U22PC481CB	CO & IoT Lab	-	-	2	2	25	50	3	1
9	U21PCN86CS	Computer Networks Lab	-	-	2	2	25	50	3	1
10	U22SI401CB	Industry Training	-	-	2	2	25	-	-	1
Total			**17**	**-**	**10**	**27**	**280**	**570**	**27**	**20**

Course Code	Course Title						Core/Elective
U21PCN01CS	Object Oriented Programming Using Java						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
PPS using C Data Structures	3	-	-	-	30	70	3

Course Objectives:

1. To understand fundamentals of object-oriented programming in Java which includes defining classes, invoking methods, difference between applet and application programs, using class libraries
2. To create Java application programs using sound OOP practices such as interfaces, exception handling, multithreading.
3. Explore I/O, language and other packages.
4. Use Collection framework, AWT and event handling to solve real world problems.
5. Exploring JDBC package to create database centric applications

Course Outcomes:

1. Understand and apply OOP concepts, Java basics, and string handling through simple Java programs.
2. Implement and differentiate inheritance, interfaces, and polymorphism in Java programs.
3. Utilize exception handling mechanisms and create multithreaded applications.
4. Manage Java I/O streams, utilize utility classes, and implement collection frameworks.
5. Develop GUI applications using AWT and perform database operations using JDBC.

UNIT-I

Introduction: OOP concepts, history of Java, Java buzzwords, data types, variables, scope and lifetime of variables, operators, expressions, control statements, type conversion and casting, simple java programs. **Classes and Objects:** Concept of classes, objects, constructors, methods, this keyword, super keyword, garbage collection, overloading methods and constructors, parameter passing, Arrays.
String handling: String, String Buffer, String Builder

UNIT-II

Inheritance: Base class object, subclass, member access rules, super uses, using final with inheritance, method overriding, abstract classes.
Interfaces: Defining and implementing an interface, differences between classes and interfaces and extending interfaces, Polymorphism.
Packages: Defining, creating and accessing a package, importing packages

UNIT-III

Exception handling: Concepts and benefits of exception handling, exception hierarchy, checked and unchecked exceptions, usage of-try, catch, throw, throws and finally, built in exceptions, creating User defined exceptions.
Multithreading: Difference between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads

UNIT-IV

Basic I/O Streams: Java I/O classes and interfaces, Files, Stream and Byte classes, Character streams, Serialization

Exploring java.lang: Object class, Wrapper classes

Exploring java.util: Scanner, StringTokenizer, Date

Collections framework: Overview, Collection interfaces: List, Set, Map Collection classes: ArrayList, LinkedList, HashSet, HashMap, Accessing Collection over Iterator, ListIterator.

UNIT-V

AWT & Event Handling:

The AWT class hierarchy, user interface components - labels, buttons, canvas, scrollbars, text components, checkbox, checkbox groups, choices, lists. Events, event sources, event classes, event listeners, delegation event model, handling mouse and key board events, adapter classes.

Layout manager: Border, Grid, Flow, Card and Grid Bag layouts.

JDBC: Database Programming using JDBC: Introduction to JDBC, JDBC Drivers & Architecture, CRUD operation Using JDBC

Text Books:

1. *Java The complete reference, 9th edition, Herbert Schildt, TMH.*
2. *Java Server Programming Java EE7 (J2EE 1.7): Black Book, (2014), Dreamtech Press*

Reference Books:

1. *Understanding OOP with Java, up dated edition, T. Budd, Pearson education.*
2. *Head First Java, 2nd Edition by Bert Bates, Kathy Sierra Publisher: O'Reilly Media, Inc.*
3. *An Introduction to programming and OO design using Java, J. Nino and F.A. Hosch, John Wiley & sons.*
4. *Database Programming with JDBC & Java, Second Edition, O'Reilly Media*

e-Resources:

1. *Programming In Java By Prof. Debasis Samanta, IIT Kharagpur - https://nptel.ac.in/courses/106105191*

Course Code	Course Title						Core/ Elective
U22PC401CB	Computer Organization and Assembly Language Programming						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
LST	3	-	-	-	30	70	3

Course Objectives

The objectives of this course is to

1. Discuss the basic concepts and structure of computers, register transfer logic and micro operations, addressing modes, instruction formats.
2. Discuss the concept of micro-programmed control unit, memory organization
3. Discuss the concept of input output organization and various serial communication standards.
4. Discuss about 8086 microprocessor and its instruction set
5. Discuss about 8086 assembly language programming and how to write 8086 ALP

Course Outcomes

After completing this course, the student will be able to:

1. Understand the theory and architecture of computer system.
2. Understand the architecture and functionality of central processing unit.
3. Exemplify in a better way the I/O and memory organization.
4. Understand instruction formats, micro operations, instruction set and addressing modes
5. Understand 8086 microprocessor and its instruction set

UNIT-I

Basic Structure of Computers: Computer Types, Functional UNIT, Basic Operational Concepts, Bus, Structures, Software, Performance, Multiprocessors and Multi Computers, Data Representation, Fixed Point Representation, Floating - Point Representation.

Register Transfer Language and Micro Operations: Register Transfer Language, Register Transfer Bus and Memory Transfers, Arithmetic Micro Operations, Logic Micro Operations, Shift Micro Operations, Arithmetic Logic Shift Unit, Instruction Codes, Computer Registers Computer Instructions - Instruction Cycle. Memory - Reference Instructions, Input – Output and Interrupt, STACK Organization, Instruction Formats, Addressing Modes, DATA Transfer and Manipulation, Program Control, Reduced Instruction Set Computer.

UNIT-II

Micro Programmed Control: Control Memory, Address Sequencing, Micro program Examples, Design of Control Unit, Hard Wired Control, Micro programmed Control.

The Memory System: Basic Concepts of Semiconductor RAM Memories, Read-Only Memories, Cache Memories Performance Considerations, Virtual Memories secondary Storage.

UNIT-III

Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer Modes, Priority Interrupt, Direct Memory Access, Input-Output Processor (IOP), Serial Communication; Introduction to Peripheral Components, Interconnect (PCI) Bus.

UNIT-IV

Introduction to 8086 Microprocessor: 8086 internal architecture. Basic 8086 microcomputer system – system overview, 8086 bus, Minimum and Maximum mode, Segment flags, memory banks, Interrupts and Interrupt responses. Addressing modes, 8086 instructions – data transfer instructions, arithmetic instructions, bit manipulation instructions, string instructions, unconditional jump instructions, condition flags, conditional jump instructions

UNIT-V

8086 Assembly language programming – program development steps, program execution, constructing the machine codes for 8086 instructions. Implementing standard program in 8086 - If-then, If-then else, and multiple if-then-else, while-do, repeat-until, loop instructions, instruction timing and delay loops.

Text Books:

1. *Computer Organization - Carl Hamacher, Zvonks Vranesic, SafeaZaky, 5th Edition, McGraw Hill.*
2. *Computer System Architecture - M. moris mano, 3rd edition, Pearson*
3. *Microprocessor 8086 programming & interfacing , A.nagoor Kani. RBA publications.*

Reference Books*:*

1. *Computer Organization and Architecture - William Stallings 6th Edition, Pearson*
2. *Structured Computer Organization - Andrew S. Tanenbaum, 4th Edition, PHI*
3. *Architecture, Programming and Interfacing - Barry B.Brey Prentice – Hall India.*
4. *The Intel Microprocessors 8086 / 8088, 80186 / 80188, 80286, 80386, 80486, Pentium, and Pentium Pro processor*

e-Resources*:*

1. *Computer architecture and organization By Prof. Indranil Sengupta, Prof. Kamalika Datta, IIT Kharagpur - https://archive.nptel.ac.in/courses/106/105/106105163/*

Course Code	Course Title						Core/ Elective
U22PC402CB	Internet of Things & Applications						Core
	Contact Hours per week						
Prerequisite	L	T	D	P	CIE	SEE	Credits
PPS using C, BE&Sensors, DBMS	3	-	-	-	30	70	3

Course Objectives:

1. Understand the principles of energy transformation and control systems.
2. Gain foundational knowledge of embedded systems and Arduino programming.
3. Explore IoT architecture, protocols, and cloud computing fundamentals.
4. Learn to utilize IoT-ready development boards for network and cloud integration.
5. Develop IoT web applications using Python and Flask, and study various IoT case applications.

Course Outcomes: On completion of this course, the student will be able to-

1. Justify IoT's role in enabling technologies
2. Suggest components of an IoT Architecture for various application sectors
3. Work with Arduino based IoT applications
4. Develop Python based IoT solutions using Raspberry Pi
5. Define requirements for IoT projects based on problem scenario

UNIT-I

Basics of Energy Transformation: Transducers

Sensors and Actuators: Taxonomy, Working Principles and Characteristic Parameters Control Systems: Introduction, Classification and Applications

UNIT-II

Embedded Systems: Introduction, Characteristics, Architecture, Applications, Advantages & Disadvantages.
Arduino: Introduction, UNO, IDE, Program Structure, Interfacing Sensors & Actuators(using Serial, PWM, i2C)

UNIT-III

Introduction to IoT, Architecture of IoT and Layers of IoT Architecture.

IoT related protocols: HTTP, MQTT, CoAP, 6LowPAN, RPL, IPV6, WiFi, Bluetooth, ZigBee, LoRaWAN.
Introduction to Cloud Computing, Cloud Service Models, Read/Write Communication APIs.
Fog & Edge Computing Fundamentals.

UNIT-IV

IoT ready Arduino products: NodeMCU and ESP32 development boards, Accessing Sensor-data & Actuators over Local Network and Cloud
Exemplary Device: Raspberry Pi, About the Board, Linux on Raspberry Pi, Motivation for using Python for IoT, Programing Raspberry Pi with Python.

UNIT-V

Developing IoT Web Applications, Python Web Application Framework - Flask.

Case Studies: Home Automation, Smart City, IoT in Agriculture, IoT in Health-Care, GDACS, IFTTT.

Text Book:

1. *Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle,"From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", Academic Press*
2. *Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on Approach)"*

Reference Books:

1. *Adrian McEwen, "Designing the Internet of Things", Wiley Publishers*
2. *Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill*
3. *Cuno Pfister, "Getting Started with the Internet of Things", O' Reilly Media*
4. *Jeeva Jose, "Internet of Things", Khanna Publishing House*

e-Resources:

1. *Introduction to internet of things, IIT Kharagpur, Prof. Sudip Misra - https://nptel.ac.in/courses/106105166*

Course Code	Course Title						Core/ Elective
U21PC401CS	Design and Analysis of Algorithms						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Data Structures	3	-	-	-	30	70	3

Course Objectives:

1. Determine performance of algorithms using asymptotic notations.
2. Formulate methodologies to solve recursive algorithms using recurrence relations.
3. Interpret algorithms using standard paradigms like: Greedy, Divide and Conquer, Dynamic Programming, Backtracking, Branch & Bound
4. Understand NP class problems and formulate solutions using standard approaches.
5. Apply algorithm design principles to derive solutions for real life problems and comment on complexity of solution.

Course Outcomes: After successful completion of this course, student will be able to:-

1. Compare complexities of algorithms written in pseudo code notation using asymptotic notation
2. Identify efficient data structures for various problems and demonstrate a suitable design technique or computing model.
3. Apply suitable algorithm design paradigm such as Divide & Conquer, Greedy etc. for the given problem.
4. Apply design paradigms Dynamic Programming, Backtracking, and Branch and Bound for the given optimization problem
5. Analyze a problem to verify if it belongs to NP complete.

UNIT-I

Introduction & Elementary Data Structures: Introduction, Fundamentals of algorithm (Line Count, Operation Count), Analysis of algorithms (Best, Average, Worst case), Asymptotic Notations(O,Ω,Θ) Recursive Algorithms, Analysis using Recurrence Relations, Master's Theorem. Review of elementary data structures–Graphs: BFS, DFS, Bi-Connected Components. Sets: representation, UNION, FIND operations.

UNIT-II

Divide-and-Conquer Method: The general method, Binary search, Finding maximum and minimum, Merge sort, Quick sort.
Brute Force: Knapsack, Traveling salesman problem, Convex-Hull

UNIT-III

Greedy Method: Knapsack problem, Minimum spanning trees, Single source shortest path, Job sequencing with deadlines, Optimal storage on tapes, Optimal merge pattern
Dynamic programming method: All pairs shortest paths, Optimal binary search tress, 0/1 Knapsack problem, Reliability design, Traveling salesman problem,

UNIT-IV

Back tracking: N-queens problem, Graph coloring, Hamiltonian cycles

Branch-and-bound: FIFO & LC branch and Bound methods, 0/1 Knapsack problem, Traveling sales person

UNIT-V

NP-hard and NP-complete problems: Non Deterministic algorithms, The classes: P, NP, NP Complete, NP Hard, Satisfiability problem, Proofs for NP Complete Problems: Clique, Vertex Cover.

Parallel Algorithms: Introduction, models for parallel computing.

Text Book:

1. *Horowitz E, Sahni S, Fundamentals of Computer Algorithms, Universities Press, 2008.*

Reference Books*:*

1. *Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, MIT Press, 2022.*
2. *Michael T. Goodrich, Roberto Tamassia, Algorithm Design: Foundations, Analysis and Internet Examples, John Wiley & Sons,2002.*

e-Resources*:*

1. *Design and Analysis of Algorithms, Chennai Mathematical Institute, Prof. Madhavan Mukund - https://nptel.ac.in/courses/106106131*

Course Code	Course Title						Core/Elective
U21PCN06CS	Computer Networks						Core
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
Operating system, Engineering Mathematics, Computer Organization and Programming Languages	3	-	-	-	30	70	3

Course Objectives:

1. To develop an understanding of communication in modern network architectures from a design and performance perspective.
2. To understand Data Transmission standards and MAC protocols.
3. To introduce the protocol's functionalities in Network Layer and Transport Layer.
4. To understand DNS and supportive application protocols.
5. To provide basic concepts of Network security.

Course Outcomes: On completion of this course, the student will be able to-

1. Explain the functions of the different layers of the OSI and TCP/IP Protocol.
2. Understand wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) describe the function of each block.
3. Illustrate network layer and transport layer protocols. For a given problem related TCP/IP protocol developed the network programming.
4. Configure DNS, EMAIL, SNMP, Bluetooth, Firewalls using open source available software and tools.
5. Apprehend the fundamentals of Network Security

UNIT-I

Data communication Components: Representation of data and its flow Networks, Layered architecture, OSI and TCP/IP model, Transmission Media.

Techniques for Bandwidth utilization: Line configuration, Multiplexing - Frequency division, Time division and Wave division, Asynchronous and Synchronous transmission, XDSL, spread spectrum.

LAN: Wired LAN (802.3), Wireless LANs (802.11x), connecting virtual LANs.

UNIT-II

Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC.

Flow Control and Error control protocols: Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggy backing.

Multiple access protocols: Pure ALOHA, Slotted ALOHA, CSMA/CD, CDMA/CA.

UNIT-III

Network Layer: Switching techniques (circuit and packet), Logical addressing – IPV4, IPV6, subnetting concepts.

Internetworking: Tunneling, Fragmentation, Congestion control.

Internet control protocols: ARP, RARP, BOOTP and DHCP, Delivery, Forwarding and Unicast Routing protocols, Gateway protocols.

UNIT-IV

Transport Layer: Process to Process Communication, Elements of transport protocol, Transmission policy.
Internet Transport Protocols: UDP, TCP, SCTP; Quality of Service.
QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

UNIT-V

Socket Programming: Socket address, Elementary socket system calls, Advanced socket system calls, Reserved ports, Socket options, Asynchronous I/O, Input/output Multiplexing, Out-of-Band data, Sockets and Signals, Internet Super Server.
Application Layer: Domain Name Space (DNS), EMAIL, SNMP, Bluetooth, VOIP,firewalls.
An introduction to Network Security: Security Components and Threats, Security Policy and Issues, Types of Malware and Attacks, Security Mechanisms.

Text Books:

1. *Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGrawHill.*
2. *Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.*
3. *W. Richard Stevens, Unix Network Programming, Prentice Hall / Pearson Education, 2009.*

References:

1. *Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.*
2. *Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.*
3. *TCP/IP Illustrated, Volume 1, W. Richard Stevens and Addison -Wesley, United States of America.*

e-Resources:

1. *Computer Networks and Internet Protocol, IIT Kharagpur, Prof. Soumya Kanti Ghosh, Prof. Sandip Chakraborty - https://nptel.ac.in/courses/106105183*

Course Code	Course Title						Core / Elective
U21MCN01PY	Essence of Indian Traditional Knowledge (Common to CSE, IT, Civil, ECE, EEE, Mech & Auto)						Mandatory Course
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	2	-	-	-	30	70	0

Course Objectives

1. To gain knowledge in Indian Culture and Philosophy
2. To know Indian Languages and Literature and the fine arts of India
3. To make students understand the gradual exploration of the Sciences and the contributions of Scholars of Ancient, Medieval and Modern India

Course Outcomes

1. Understand Indian philosophy and culture
2. Identify the various Indian languages and the literature available in them.
3. Realize the rationality behind Vedic Sciences
4. Acquire the information about the Indian fine arts and Cultural Heritage.
5. Know the evolution of Indian education system and the contributions of scientists of different eras.

UNIT-I --- INDIAN CULTURE (6 hrs)

Introduction to Culture: Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India.

UNIT-II --- INDIAN LANGUAGES & LITERATURE (6 hrs)

Indian Languages, Culture and Literature: Indian Languages and Literature-I: the role of Sanskrit, significance of scriptures to current society, Indian philosophies, other Sanskrit literature, and literature of south India.

Indian Languages and Literature-II: Northern Indian languages & literature.

UNIT-III --- ESSENCE OF VEDIC SCIENCES (6 hrs)

Scientific approach (Mathematics: Baudhayana Sulvasutra; Geography: Mahasankalpa; Astronomy: Bruhat samhit) in Vedic Literature and proper understanding of Indian Religious literature (dashopanishats) & Practices (Meaning of mahasankalpa,Vastugunadeepika). Western understanding of Indian philosophy. Reform Movements in Modern India (Bhakti & Sufi movements & Reforms of Raja Rammohan Roy, Dayananda Saraswati, Swamy Vivekananda, Aligarh movement and Jyoti Rao pule only).

UNIT-IV --- INDIAN FINE ARTS (6 hrs)

Fine Arts in India (Art, Technology & Engineering): Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India.

UNIT-V --- EVOLUTION OF EDUCATION SYSTEM IN INDIA (6 hrs)

Education System in India: Education in ancient, medieval and modern India, aims of education. Subjects and languages taught in various periods. Sciences and Scholars of Ancient India, Medieval India, and Scientists of Modern India.

Suggested books:

1. *Kapil Kapoor, 'Text and Interpretation: The India Tradition', ISBN: 81246033375, 2005*
2. *'Science in Samskrit', Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007.*
3. *NCERT, "Position paper on Arts, Music, Dance and Theatre" NCERT, New Delhi, 2010.*
4. *P. Priyadarshi,"Zero is not the only story", India First Foundation,ISBN:81-89072-14-5,2007.*
5. *Satya Prakash, "Founders of Sciences in Ancient India", Vijay Kumar Publisher, New Delhi, 1989.*
6. *M. Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, New Delhi, 2005.*

Course Code	Course Title						Core/Elective
U21PCN81CS	Object Oriented Programming Using Java Lab						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
PPS using C DBMS	L	T	D	P			
	-	-	-	4	25	50	2

Course Objectives:

The objectives of the course are to impart knowledge of:

1. Master Java's object-oriented programming concepts, including method overloading and inheritance.
2. Develop proficiency in handling data input, parsing, and exception management using Java utilities and threading.
3. Implement Java interfaces, abstract classes, and inter-thread communication with practical applications.
4. Explore Java's collection framework, file I/O operations, and serialization techniques.
5. Perform database operations and create interactive applications using JDBC and Java AWT for event handling.

Course Outcomes:

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

1. Develop Java applications using the concepts of Inheritance, interfaces, packages, access control specifiers.
2. Implement the concepts of Exception Handling in java Applications.
3. Read and write data using different Java I/O streams.
4. Create graphical user interfaces and Applets by applying the knowledge of Event Handling.
5. Create robust applications using Java standard class libraries and retrieve data from a database with JDBC.

List of Experiments

1. Write a Java program to illustrate the concept of class with method overloading
2. Write a Java Program that reads a line of integers, and then displays each integer, and the sum of all the integers (Use StringTokenizer class of java.util)
3. Write a Java program to illustrate the concept of Single level and Multi level Inheritance.
4. Write a Java program to demonstrate the Interfaces & Abstract Classes.
5. Write a Java program to implement the concept of exception handling.
6. Write a Java program to illustrate the concept of threading using Thread Class and Runnable Interface.
7. Write a Java program that correctly implements producer consumer problem using the concept of inter thread communication.
8. Write a Java program to illustrate collection classes like Array List, Linked List, TreeMap and HashMap.
9. Write a Java program to implement iteration over Collection using Iterator interface and ListIterator interface
10. Write a Java program that reads a file name from the user, and then displays information about whether the file exists, whether the file is readable, whether the file is writable, the type of file and

the length of the file in bytes.

11. Write a Java program to illustrate the concept of I/O Streams
12. Write a Java program to implement serialization concept
13. Write a Java program to perform following CRUD operations on student data using JDBC
    i. create & insert a student record
    ii. retrieve and display the existing student records
    iii. update & delete a student record
14. Write a Java awt program for handling mouse & key events
15. Write a Java awt program to implement Adapter classes.

Suggested Tools: *NetBeans, Eclipse, MySQL Community Server, MySQL Workbench*

Course Code	Course Title						Core/Elective
U22PC481CB	CO & IoT LAB						Core
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
PPS using C, PS using Python, LST, DBMS	-	--	-	2	25	50	1

Course Objectives:

1. Understanding of Assembly Language Programming
2. Identify the vision and understand the basics of IoT
3. Impart necessary and practical knowledge over various components of IoT
4. Cultivate skills required to build real-time IoT based projects
5. Propose solutions to IoT projects suitable for social or business problem

Course Outcomes:

On completion of this course, the student will be able to-

1. Understand 8086 Programming
2. Understand IoT's hardware and software components
3. Interface I/O devices, sensors & communication module
4. Analyze the use of communication protocols in IoT
5. Remotely monitor data and control devices.

LIST OF EXPERIMENTS

1. Write an ALP program to perform 16 Bit arithmetic operations using 8086 Trainer Kit.
2. Write an ALP program to perform 16 Bit Logical operations using 8086 Trainer Kit.
3. Write an ALP program to perform multi byte addition and subtraction.
4. Write an ALP program to perform ascending order using 8086 Trainer Kit.
5. Write an ALP program to perform descending order using 8086 48
6. Write an ALP program to compute largest of the given array using 8086 Trainer Kit.
7. Write an ALP program to compute smallest of the given array using 8086 Trainer Kit.

It is suggested to practice the experiments in a simulated environment before handling real time components to avoid unnecessary wear and tear.

1. Setting up the software development environment for the IoT development board.
2. Controlling physical entities (Eg. light, sound etc..) by interfacing with actuators
3. Capturing environment variables (Eg. temperature, light etc..) by interfacing with sensors
4. Integrating sensor and actuator logic for building a simple control system
5. Controlling IoT physical entities using a Smart-Device by establishing a local network
6. Viewing IoT sensor data on Smart-Device by a establishing a local network
7. Setting up a simple Cloud Server and API (UI, middleware and database)
8. Controlling physical entities using IoT via internet using a Cloud Server API
9. Capturing IoT sensor data at a Cloud Server API and presenting sensor values on a UI
10. Data visualization (Eg. charts/graphs) of IoT sensor data by a Cloud Server for UI
11. Integrating IoT devices via Cloud Server API for automation

Suggested additional experiment for micro-processor based IoT development boards only:-
Developing an Edge Server (HTTP/MQTT based) for handling local IoT devices

Suggested Tools: *CISCO Packet tracer, TinkerCAD, Wokwi, MicroPython, Wyliodrin, Blynk, Thingspeak, AwardSpace, 000WebHost, PythonAnyWhere*

Course Code	Course Title						Core/Elective
U21PCN86CS	Computer Networks Lab						Core
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
Engineering Mathematics, Programming for problem solving, Operating Systems	-	-	-	2	25	50	1

Course Objectives:

1. Master the use of essential network commands and services for network diagnostics and monitoring.
2. Gain proficiency in configuring routers and switches using both real devices and simulation tools.
3. Develop skills in socket programming with UDP and TCP to create network-based applications.
4. Learn to analyze network packets using advanced tools like Wireshark and tcpdump.
5. Acquire the ability to simulate network scenarios and evaluate performance using various network simulation tools.

Course Outcomes:

On completion of this course, the student will be able to-

1. Effectively utilize network commands and services for troubleshooting and analysis.
2. Configure and manage network devices such as routers and switches.
3. Develop and test applications using socket programming techniques.
4. Capture and analyze network traffic with network protocol analyzers.
5. Simulate and assess network behaviors and performance using simulation software.

LIST OF EXPERIMENTS

To use simulation tools to analyze the performance of various network protocols

1. Running and using services/commands like tcpdump, netstat, ifconfig, nslookup, FTP, TELNET and traceroute. Capture ping and trace route PDUs using a network protocol analyzer and examine.
2. Configuration of router, switch. (Using real devices or simulators)
3. Socket programming using UDP and TCP (e.g., simple DNS, data & time client/server, echo client/server, iterative & concurrent servers)
4. Network packet analysis using tools like Wireshark, tcpdump, etc.
5. Network simulation using tools like Cisco Packet Tracer, NetSim, OMNeT++, NS2, NS3, etc.
6. Study of Network simulator (NS) and Simulation of Congestion Control Algorithms using NS. Performance evaluation of Routing protocols using Simulation tools.
7. Programming using raw sockets.
8. Programming using RPC.

Suggested Tools: *CISCO Packet tracer, NS2, Wire Shark, NMAP*

Course Code	Course Title						Core/ Elective
U22SI401CB	Industry Training						Core
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
PPSC, PSP, DS&A, DBMS	-	--	-	2	25	-	1

Course Objectives:

1. Expose students to real-world industry environments and practices.
2. Develop hands-on experience with industry-standard tools and technologies.
3. Enhance problem-solving skills through practical project work.
4. Foster professional communication and teamwork abilities.
5. Bridge the gap between theoretical knowledge and industrial application.

Course Outcomes:

On completion of this course, the student will be able to-

1. Apply industry-standard tools and techniques in practical scenarios.
2. Demonstrate effective problem-solving skills in a professional setting.
3. Exhibit strong teamwork and communication skills in a collaborative environment.
4. Integrate theoretical knowledge with practical industrial applications.
5. Produce professional reports and presentations based on industrial project experiences.

INSTRUCTIONS:

1. *Students need to undergo training in an industry liaison academy course.*
2. *Students need to submit a course completion certificate.*
3. *Internal review/evaluation will be done for the respective course.*

R21-BE CSE (IoT-CS-BcT) SEMESTER-V

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/ Drg	Contact Hrs/ week	CIE	SEE	Duration of SEE (Hrs.)	
Theory Courses-										
1	U22PCN01CB	Web Technologies	3	-	-	3	30	70	3	3
2	U21PCN02CS	Software Engineering	3	-	-	3	30	70	3	3
3	U21PCN04CS	Operating Systems	3	-	-	3	30	70	3	3
4	U21PCN05CS	Automata Languages and Computation	3	-	-	3	30	70	3	3
5	U22PC501CB	Cyber Security	3	-	-	3	30	70	3	3
6	U22PE51XXX	Professional Elective - I	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
7	U22PCN81CB	Web Technologies Lab	-	-	2	2	25	50	3	1
8	U21PCN84CS	Operating Systems Lab	-	-	2	2	25	50	3	1
9	U22PC581CB	Cyber Security Lab	-	-	2	2	25	50	3	1
10	U22PW581CB	Mini-Project	-	-	4	4	25	50	3	2
Total			**18**	**0**	**10**	**28**	**280**	**620**	**30**	**23**

Professional Elective – I		
S.No.	**Course Code**	**Course Title**
1	U22PE511CB	Compiler Design
2	U22PE512CB	Embedded Systems
3	U22PE513AL	Image Processing
4	U22PE514CB	Service Oriented Architecture
5	U22PE515DS	Game Development

Course Code	Course Title						Core/ Elective
U22PCN01CB	**Web Technologies**						Core
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
OS, CN, OOP	3	-	-	-	30	70	3

Course Objectives:

1. To understand the fundamental principles and protocols of the web.
2. To develop and deploy dynamic and responsive web applications.
3. To explore client-side and server-side web development technologies.
4. To implement best practices for web security and performance optimization.
5. To analyze and integrate web services and APIs in web projects.

Course Outcomes:

On completion of this course, the student will be able to-

1. Develop web pages using HTML and CSS, enhancing their structure and style.
2. Implement dynamic web interactions using JavaScript and DOM manipulation.
3. Build and manage user interfaces with React, leveraging components and hooks.
4. Create server-side applications using Node.js and Express, utilizing built-in modules and templating engines.
5. Integrate MongoDB with Node.js projects, applying database management and MVC architecture

UNIT-I

Web Essentials: Clients, Servers, and Communication, Markup Languages (HTML, XML & XHTML), Representing Web Data: XML, Style Sheets: CSS

UNIT-II

Client-Side Programming: The JavaScript Language, Host Objects: Browsers and the DOM

UNIT-III

React JS: Hello, World! , The Foundation of React , JSX, Components(Props), Data Flow, Events, Forms, Styling React, Hooks, Routing

UNIT-IV

Node JS: Introduction, Built-in Modules(http,url,fs), NPM, Express, Templating Engine(EJS: Embedded JavaScript),

UNIT-V

Introduction to MongoDB, Using MongoDB Atlas, Applying MongoDB to our NodeJS Projects, Refactoring to MVC

Text Books:

1. *Web Technologies:A Computer Science Perspective, Jeffrey C. Jackson, Pearson*
2. *ReactJS Foundations:Building User Interfaces with ReactJS, Chris Minnick, 2022 by John Wiley & Sons, Wrox - https://github.com/chrisminnick/react-js-foundations*
3. *Beginning MERN Stack Development, Greg Lim, 2021, Barnes & Noble*

Reference(s):

1. *Tim Berners-Lee with Mark Fischetti, Weaving the Web : The Original Design and Ultimate Destiny of the World Wide Web by its Inventor, Harper San Francisco, 1999*
2. *Programming the World Wide Web, Robert W. Sebesta, 2011, Pearson*
3. *MERN Quick Start Guide, Eddy Wilson, Packt Publishing Ltd, 2018*
4. *Pro MERN Stack, Vasan Subramanian, Second Edition, 2019, APRESS*

e-Resources:

1. *Free Code Camp – Related courses/modules as per syllabus*
2. *MongoDB Node.js Developer Path, MongoDB University - https://learn.mongodb.com/learning-paths/mongodb-nodejs-developer-path*

Course Code	Course Title						Core/Elective
U21PCN02CS	Software Engineering						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Programming Skills in Java	3	-	-	-	30	70	3

Course Objectives:

1. To introduce the basic concepts of software development processes from defining a product to shipping and maintaining
2. To impart knowledge on various phases, methodologies and practices of software development
3. To understand the importance of testing in software development, study various testing strategies along with its relationship with software quality and metrics.
4. To have knowledge on various Architectural styles and User Interface design.
5. To know the Software Configuration Management and maintain the product metrics.

Course Outcomes:

Student will be able to:

1. Acquired working knowledge of alternative approaches and techniques for each phase of software development.
2. Illustrate an appropriate process model(s) assessing software project attributes and analyze necessary requirements for project development eventually composing SRS
3. Creation of visual models to describe (non-) algorithmic solutions for projects using various design principles.
4. Acquire skills necessary as an independent or as part of a team for architecting a complete software project by identifying solutions for recurring problems exerting knowledge on patterns.
5. Concede product quality through testing techniques employing appropriate metrics by understanding the practical challenges associated with the development of a significant software system.

UNIT-I

Introduction to Software Engineering: Definition of Software Engineering, The Software Process, A Generic Process Model, Process Assessment and Improvement.

Perspective Process Models: The Waterfall Model, Incremental Process Models, Evolutionary Process Models, The Unified Process, Personal and Team Process Models

Agile Development: Agility, Agile Process, Agile Process Models (XP, Scrum).

UNIT-II

Software Engineering Principles: Core Principles, Communication principles, Planning principles, Modeling principles, Construction principles, Deployment principles.
Requirements Engineering: Identifying Stakeholders, Requirements Engineering Tasks, Eliciting Requirements, Developing Use-Cases, Building the Requirements Model, Negotiating Requirements, Validating Requirements.

UNIT-III
Building the Analysis Model: Requirements Analysis, Modeling Approaches, Scenario-based Modeling, Data Modeling Concepts, Class-based Modeling.
Design Engineering: Design within the context of SE, Design Process, Design Concepts, The Design Model.

UNIT-IV
Architectural Design: Software Architecture, Architectural Styles, Architectural Design. **Component-Level Design:** Definition of Component, Designing Class-based Components, Conducting Component-level Design, Designing Traditional Components.
User Interface Design: The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation.

UNIT-V
Software Quality: Definition, Quality Assurance, Six Sigma, ISO 9000 Quality Standards **Testing:** Test Strategies for Conventional Software, Test Strategies for O-O Software, Validation Testing (Alpha and Beta Testing), System testing, White-Box Testing, Black-Box Testing **The Art of Debugging:** Debugging Process, Debugging Strategies.
Software Configuration Management: SCM Repository, SCM Process.
Product Metrics: A Framework for Product Metrics, Metrics for Source Code, Metrics for Maintenance.

Text Book:

1. *Roger S. Pressman, Software Engineering: A Practitioner's Approach, 7th Edition, McGraw Hill, 2009.*
2. *Clean Architecture: A Craftsman's Guide to Software Structure and Design Robert C. Martin Edition: 1st edition 2023.*

Reference Books:

1. *Ali Behforooz and Frederick J. Hudson, Software Engineering Fundamentals, Oxford University Press, 1996.*
2. *Pankaj Jalote, An Integrated Approach to Software Engineering, 3rd Edition, Narosa Publishing House, 2008.*

e-Resources:

Software Engineering, IIT Kharagpur, Prof. Rajib Mall - https://nptel.ac.in/courses/106105182

Course Code	Course Title						Core/Elective
U21PCN04CS	Operating Systems						Core
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
Good knowledge of C, Computer Organization and Architecture, Data Structures	3	-	-	-	30	70	3

Course Objectives:

1. Explore computer system hardware and OS evolution.
2. Manage processes, threads, and scheduling algorithms.
3. Handle process synchronization and deadlock issues.
4. Optimize memory and secondary storage systems.
5. Manage files efficiently and ensure system protection.

Course Outcomes:

After completion of the course the student is able to:

1. Understand OS evolution and system software types.
2. Master process control and scheduling algorithms.
3. Implement synchronization for mutual exclusion.
4. Apply memory techniques for optimal system performance.
5. Propose efficient file systems for data management.

UNIT-I

Computer System and Operating System Overview: Overview of Computer System hardware, Operating System Objectives and functions, Evolution of operating System, Example Systems. Operating System Services, System Calls, System Programs.

UNIT-II

Process Management: Process Description, Process Control Block, Process States

Threads: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads.

Process Scheduling: Scheduling Queues, Schedulers, Scheduling Criteria, Scheduling algorithms, Multiprocessor Scheduling. Case Studies: Linux, Windows.

UNIT-III

Process Synchronization: Inter-process Communication - Background, The Critical Section Problem, Race Conditions, Mutual Exclusion, Peterson's solution, Synchronization Hardware, Semaphores, Classic Problems of Synchronization - Bounded Buffer Problem, The Producer/ Consumer Problem, Reader's & Writer's Problem, Dinning Philosopher Problem, Event counters, Monitors, Message passing.

Deadlocks: Deadlocks - System Model, Deadlock Characterization - Necessary and sufficient conditions for Deadlock, Methods for Handling Deadlocks - Deadlock Prevention, Deadlock Avoidance, Deadlock Detection and Recovery from Deadlock.

UNIT-IV

Memory Management: Basic concepts, Swapping, Contiguous memory allocation, Paging, Segmentation, Virtual memory, Demand paging, Page-replacement algorithms, Thrashing.

Secondary storage structure: Disk structure; Disk scheduling, Disk management, Swap-space Management, RAID structure, Stable-storage Implementation, Tertiary-Storage Structure.

UNIT-V

File Management: Concept of File - Attributes, operations, file types, internal structure, access methods, Directory structure, file protection, file system structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.

Protection: System Protection, Goals of Protection, Principles of Protection.

Text Books:

1. *Abraham Silberschatz, Peter B.Galvin and Greg Gagne, Operating System Concepts, 9th Edition, Wiley Asia Student Edition.*
2. *William Stallings, Operating Systems: Internals and Design Principles, 5th Edition, Prentice Hall of India 2022.*

Reference Books:

1. *Charles Crowley, Operating System: A Design-oriented Approach, 1st Edition, Irwin Publishing.*
2. *Gary J. Nutt and Addison, Operating Systems: A Modern Perspective, 2nd Edition, Wesley.*
3. *Maurice Bach, Design of the UNIX Operating Systems, 8th Edition, Prentice Hall of India.*
4. *Daniel P. Bovet and Marco Cesati, Understanding the Linux Kernel, 3rd Edition, O'Reilly and Associates.*

e-Resources:

Operating System Fundamentals, IIT Kharagpur, Prof. Santanu Chattopadhyay - https://nptel.ac.in/courses/106105214

Course Code	Course Title						Core/ Elective
U21PCN05CS	Automata Languages and Computation						Core
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
Logic and Switching Theory, Data Structures	3	-	-	-	30	70	3

Course Objectives:

1. Understand finite state automata and their applications in deterministic and non-deterministic scenarios.
2. Relate regular expressions and laws to describe and manipulate regular languages effectively.
3. Analyze properties of regular languages using the Pumping Lemma and Myhill-Nerode Theorem.
4. Explore context-free grammars, parse trees, and resolve ambiguities in languages.
5. Investigate Turing machines, variations, undecidability, and the Chomsky hierarchy in language theory.

Course Outcomes:

After completing this course, the student will be able to:

1. Design Finite Automata for Regular languages.
2. Apply formal mathematical methods to prove properties of languages, grammars and automata.
3. Analyze the language and Design pushdown automata.
4. Design Turing machines for simple problems.
5. Describe and determine the undecidability of a problem.

UNIT-I

Automata: Introduction to Finite state automata, Central Concepts of Automata theory.
Finite Automata: Deterministic finite Automata, Non-deterministic finite state automata, Finite Automata with Epsilon -Transitions, Applications of Finite Automata.
Regular Expressions and Languages: Regular expressions, Applications of Regular expressions, Algebraic Laws for Regular expressions,

UNIT-II

Properties of Regular Languages: Properties of regular sets, Pumping Lemma, Closure properties of Regular languages, Decision Properties of Regular languages, Myhill-Nerode Theorem, Minimization of Finite Automata.

Context Free Grammars and Languages: Context Free Grammars,Derivations,Parse-Trees,
Applications of Context Free Grammars, Ambiguity in Grammars and Languages.

UNIT-III

Pushdown Automata: Definitions, The languages of a PDA,Equivalence of PDA's and CFG's, Deterministic Pushdown Automata.

Properties of Context Free Languages: Normal Forms for Context Free Grammars, Pumping Lemma for Context free languages, Closure Properties of CFL's, Deterministic Context free Languages, Decision properties of CFL's.

UNIT-IV

Turing Machines: Introduction, Computational Languages and Functions, Programming Techniques for construction of Turing machines, Modifications of Turing Machine, Turing machine as Enumerator, Restricted Turing machine.

UNIT-V

Undecidability: Recursive and Recursively Enumerable languages, Universal Turing machine and Undecidable problems, Rice Theorem, Post's Correspondence problem. Chomsky's Hierarchy-Regular grammars, Unrestricted grammar, CSL, Relationship between classes of languages.

Text Books:

1. *John. E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Introduction to Automata Theory, Languages and Computation, 3rd edition (2009), Pearson Education.*

Reference Books:

1. *John C.Martin, Introduction to Languages and the Theory of Computation, 3rd Edition (2003) Tata McGraw Hill.*
2. *Michael Sipser, Introduction to Theory of Computation, 3rd Edition (2012), Course Technology .*

e-Resources:

Introduction to Automata, Languages and Computation, IIT Kharagpur, Prof. Sourav Mukhopadhyay - https://nptel.ac.in/courses/106105196

Course Code	Course Title						Core/ Elective
U22PC501CB	Cyber Security						Core
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
Computer Networks, Operating systems	3	-	-	-	30	70	3

Course Objectives:

1. To learn cybercrime and cyberlaw.
2. To understand the cyber attacks and tools for mitigating them.
3. To understand information gathering.
4. To learn how to detect a cyber attack.
5. To learn how to prevent a cyber attack.

Course Outcomes:

After completing this course, the student will be able to:

1. Explain the basics of cyber security, cyber crime and cyber law
2. Classify various types of attacks and learn the tools to launch the attacks
3. Apply various tools to perform information gathering
4. Apply intrusion techniques to detect intrusion
5. Apply intrusion prevention techniques to prevent intrusion

UNIT-I

Introduction

Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts -History of Internet – Impact of Internet – CIA Triad; Reason for Cyber Crime –Need for Cyber Security – History of Cyber Crime; Cybercriminals –Classification of Cybercrimes– A Global Perspective on Cyber Crimes; Cyber Laws – The Indian IT Act – Cybercrime and Punishment.

UNIT-II

Attacks And Countermeasures

OSWAP; Malicious Attack Threats and Vulnerabilities: Scope of Cyber-Attacks – Security Breach– Types of Malicious Attacks – Malicious Software – Common Attack Vectors – Social engineeringAttack – Wireless Network Attack – Web Application Attack – Attack Tools – Countermeasures.

UNIT-III

Reconnaissance

Harvester – Whois – Netcraft – Host – Extracting Information from DNS – Extracting Information from E-mail Servers – Social Engineering Reconnaissance; Scanning – Port Scanning – Network Scanning and Vulnerability Scanning – Scanning Methodology – Ping Sweer Techniques – Nmap Command Switches – SYN – Stealth – XMAS – NULL – IDLE – FIN Scans – Banner Grabbing and OS Finger printing Techniques

UNIT-IV

Intrusion Detection

Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort.

UNIT-V

Intrusion Prevention

Firewalls and Intrusion Prevention Systems: Need for Firewalls – Firewall Characteristics and Access Policy – Types of Firewalls – Firewall Basing – Firewall Location and Configurations – Intrusion Prevention Systems – Example Unified Threat Management Products

Text Books

1. *Anand Shinde, "Introduction to Cyber Security Guide to the World of Cyber Security", Notion Press, 2021*
2. *David Kim, Michael G. Solomon, "Fundamentals of Information Systems Security", Jones & Bartlett Learning Publishers, 2013*
3. *Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made easy", Elsevier, 2011*

Reference Books

1. *Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley Publishers, 2011*
2. *Kimberly Graves, "CEH Official Certified Ethical hacker Review Guide", Wiley Publishers, 2007*
3. *William Stallings, Lawrie Brown, "Computer Security Principles and Practice", Third Edition, Pearson Education, 2015*

e-Resources

Cyber Security and Privacy, IIT Madras, Prof. Saji K Mathew - https://nptel.ac.in/courses/106106248

PROFESSIONAL ELECTIVE -I

Course Code	Course Title						Core/Elective
U22PE511CB	Compiler Design						Elective
Prerequisite	Contact Hours per Week		CIE		SEE		Credits
	L	T	D	P			
DSA, ALC	3	-	-	-	30	70	3

Course Objectives: The main objectives of this course are to

1. Learn the phases of compilation and the interactions between different components of a compiler.
2. Understand the role and significance of syntax analysis in the compilation process.
3. Understand the fundamentals of syntax directed translation and its role in compiler design.
4. Explore the principal sources of machine-independent optimizations.
5. Understand the fundamental concepts and importance of code generation in the compilation process.

Course Outcomes:

On completion of this course, the student will be able to-

1. Design Lexical Analyzer for a given Language.
2. Design Parsers using Top-Down and Bottom-Up parsing techniques.
3. Develop Syntax Directed Translation Schemes.
4. Apply machine-independent optimization techniques to improve the efficiency of intermediate code.
5. Apply knowledge of target languages and implement basic peephole optimization techniques to improve the efficiency of generated code.

UNIT-I

Introduction: Language Processors, The Structure of a Compiler.

Lexical Analysis: The Role of Lexical Analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens, The Lexical-Analyzer Generator-LEX.

UNIT-II

Syntax Analysis: Introduction, Top-Down Parsing- Recursive Descent Parsing, Predictive Parsing, LL(1) Grammars. Bottom-Up Parsing- Shift-Reduce Parsing, Introduction to LR Parsing- SLR, More Powerful LR Parsers- CLR and LALR, The Parser Generator- YACC.

UNIT-III

Syntax Directed Translation: Introduction, Syntax Directed Definitions, Evaluation Orders for SDD's, Applications of Syntax Directed Translation.

Intermediate Code Generation: Variants of Syntax Trees, Three-Address Code, Types and Declarations, Translation of Expressions, Type Checking.

UNIT-IV

Run-Time Environments: Storage Organization, Stack Allocation of Space, Access to Non-local Data on the Stack.

Code Optimization: Introduction, Basic Blocks and Flow Graphs, Machine Independent Optimizations – The Principal Sources of Optimizations.

UNIT-V

Code Generation: Introduction, Issues in the Design of a Code Generator, The Target Language, Peephole Optimization, Register Allocation and Assignment.

Text Books:

1. *Alfred V Aho, Monica S Lam, Ravi Sethi, Jeffrey D Ullman, Compilers: Principles, Techniques& Tools,2nd Edition(2007), Pearson Education.*
2. *Kenneth C Louden , Compiler Construction: Principles and Practice, 2ndEdition(2005) ,Cengage Learning.*

References:

1. *P.Trembley and P.S.Sorenson, The Theory and Practice of compiler writing,TMH-1985.*
2. *Keith d Cooper & Linda Tarezon, Engineering a Compiler,2ndEdition(2011), Morgan Kafman.*
3. *JohnRLevine,TonyMason,DougBrownLex&Yacc,3rdEdition(2007), Shroff Publisher .*
4. *John R Levine, Lex&Yacc, 2ndEdition(2009), Oreilly Publishers.*

e-Resources:

1. *https://nptel.ac.in/courses/106108052/*
2. *http://openclassroom.stanford.edu/MainFolder/CoursePage.php?course=Compilers*

Course Code	Course Title						Core/ Elective
U22PE512CB	Embedded Systems						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Microprocessor and Microcontrollers	3	-	-	-	30	70	3

Course Objectives: The main objectives of this course are to

1. Understand the fundamentals of embedded computing, covering complex systems, microprocessors, and the design process.
2. Familiarize with instruction sets, with a focus on ARM processor architecture.
3. Gain knowledge of CPU programming, input/output operations, memory systems, and computing platforms.
4. Learn about real-time operating systems (RTOS), including task and memory management, and interrupt routines.
5. Explore multirate systems, network and multiprocessor categories, and tools for embedded software development.

Course Outcomes:
After completing this course, the student will be able to:

1. Ability to comprehend the principles and components of embedded computing systems.
2. Proficiency in designing embedded systems using microprocessors and complex system formalisms.
3. Skill in programming CPUs, managing input/output operations, and optimizing CPU performance and power consumption.
4. Competence in utilizing real-time operating systems for task and memory management in embedded systems.
5. Proficiency in developing embedded software, employing debugging techniques, and integrating software into target systems.

UNIT-I
Embedded Computing: Introduction, Complex Systems and Microprocessor; Embedded System Design Process, Formalisms for System Design, Design Examples.
Instruction Set: Preliminaries, ARM Processor.

UNIT-II
CPU's: Programming Input and output. Supervisor mode, exceptions, traps, Co-processors, Memory system Mechanisms, CPU Performance, CPU Power Consumption Computing Platforms: Basic Computing Platforms, CPU bus, memory device and system, consumer electronics architecture, platform level performance analysis, design example.

UNIT-III

Introduction to Real-Time Operating Systems: Tasks and Task States, Tasks and Data, Semaphores, Shared Data, Message Queues, Mailboxes and Pipes, Timer Functions, Events, Memory Management, Interrupt Routines in an RTOS Environment.

Basic Design Using a Real-Time Operating System: Principles, Semaphores and Queues, Hard Real-Time Scheduling Considerations, Saving Memory and Power, An example RTOS like UC-OS(Open Source).

UNIT-IV

Multirate systems: priority based scheduling, evaluating operating system performance

Network and multiprocessor: Network and multiprocessor categories, Distributed embedded processors, MPSoCs and shared memory multiprocessors, Design example.

UNIT-V

Embedded Software Development Tools: Host and Target machines, Linker/Locators for Embedded Software, Getting Embedded. Software into the Target System.

Debugging Techniques: Testing on Host Machine, Using Laboratory Tools, An Example System.

Text Books:

1. *Computers as Components: Principles of Embedded Computing System Design, Fifth Edition-2022*
2. *An Embedded Software Primer, David E.Simor, Pearson Education.*

References:

1. *Embedded Systems- Architecture, Programming and Design , Raj Kamal, 3rd Edition – 1 July 2017*
2. *Embedding System building blocks, Labrosse, via CMP Publishers.*

e-Resources:

1. *Embedded Systems Design, IIT Kharagpur, Prof. Anupam Basu - https://nptel.ac.in/courses/106105159*

Course Code	Course Title						Core/ Elective
U22PE513AL	Image Processing						Elective
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
Introduction to Linear Algebra, Signals and Systems	3	-	-	-	30	70	3

Course Objectives:

1. To introduce basics of visual perception, sampling, quantization and representation of digital images
2. To introduce spatial and frequency Domain filtering techniques necessary for Image processing operations
3. To learn image analysis methods like image restoration, image compression and segmentation
4. To understand about noise in images and its filtering process
5. To introduce color image processing fundamentals and models

Course Outcomes: At the end of the course, students will be able to

1. Distinguish sampling and quantization processes in obtaining digital images from continuously sensed data and describe the steps in image processing.
2. Apply Fourier transformation and other transformation techniques to enhance digital image.
3. Apply different techniques in spatial domain and frequency domain to enhance and segment digital images.
4. Describe different methods to encode raw image data into standard compressed image format.
5. Demonstrate most commonly applied image restoration and color models and their use in basic image processing.

UNIT-I

Introduction to Digital Image Processing, Origins and Applications of Digital Image Processing. Fundamental Steps in Digital Image Processing, Components of Digital Image Processing System. Elements of Visual Perception, Light and the Electromagnetic Spectrum, Image Sensing and Acquisition, Image Sampling and Quantization, basic relationship between pixels.

UNIT-II

Filtering in the Frequency Domain: Preliminary Concepts, Sampling and the Fourier Transform of Sampled Functions, The Discrete Fourier Transform (DFT) of One Variable, Extension to Function of Two Variables, Image Smoothing and Sharpening using Frequency Domain Filters.

UNIT-III

Intensity Transformations and Spatial Filtering: Histogram Processing, Fundamental of Spatial Filtering, Smoothing and Sharpening Spatial Filters. Image Segmentation: Point, Line and Edge Detection, Thresholding, Region-Based Segmentation.

UNIT-IV

Image Compression: Fidelity Criteria, Image Compression Models, Image Formats, Containers and Compression Standards, Compression Methods: Huffman Coding, Golomb Coding, Arithmetic Coding, LZW Coding, Run-Length Coding.

UNIT-V

Restoration: Noise Models, Inverse filtering, Least squares Filtering.

Color Image Processing : Color fundamentals, color models, Pseudo color Image Processing, Basics of full color image processing.

Text Books:

1. *Gonzalez R.C., Woods R.E, Digital Image Processing, Third Edition 2007, Prentice Hall, USA.*
2. *Jayaraman S, Esakkirajan S, Veerakumar T, Digital image processing, 13th reprint 2014,McGraw Hill Education, New Delhi.*

Reference Books:

1. *William K. Pratt, Digital Image Processing, 3rd Edition 2001, John Wiley & Sons Inc, UK.*
2. *Mc Andrew, Introduction to Digital Image Processing, Cengage Learning 2004.*
3. *Sonka, Hlavac, Boyle, Digital Image Processing and Computer Vision, Cengage Learning 2008.*
4. *Rosenfeld A. Kak AC, Digital Picture Processing Vol .I & II Acad, Press, 2nd edition 2010.*

e-Resources:

Digital Image Processing, IIT Kharagpur, Prof. P.K. Biswas - https://nptel.ac.in/courses/117105135

Course Code	Course Title						Core/Elective
U22PE514CB	**Service Oriented Architecture**						Elective
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
PPS, DSA	3	-	-	-	30	70	3

Course Objectives:

1. Students will learn the basic principles and concepts of Service-Oriented Architecture, including the definition of services, the importance of loose coupling, and the benefits of reusability and interoperability.
2. Students will gain practical skills in designing and developing SOA-based solutions, focusing on creating, deploying, and managing services that align with business processes and requirements.
3. Students will explore and apply key SOA standards and protocols such as SOAP, REST, WSDL, UDDI, and XML to ensure compatibility and communication between different services and platforms.
4. Students will learn strategies for integrating SOA with legacy systems and other enterprise architectures, understanding how to leverage existing IT assets while transitioning to a service-oriented environment.
5. Students will understand the importance of security and governance in SOA, learning best practices for securing services, managing identities, and ensuring compliance with organizational policies and regulatory requirements.

Course Outcomes:

On completion of this course, the student will be able to-

1. Understand and apply the fundamental concepts of XML, including document structure, well-formed and valid documents, namespaces, DTDs, and XML Schema to create and validate XML documents.
2. Develop XML-based applications by parsing XML documents using DOM and SAX, transforming XML with XSL, and modeling databases in XML.
3. Explain the characteristics and principles of Service-Oriented Architecture (SOA), compare it with traditional client-server and distributed architectures, and articulate the benefits and service layers of SOA.
4. Design and implement web services using WSDL for service descriptions, SOAP for messaging, UDDI for service discovery, and understand advanced concepts like message exchange patterns, orchestration, choreography, and WS Transactions.
5. Apply service-oriented analysis and design methodologies to model and design SOA-based applications, utilizing standards and guidelines, and implement composition, WS-BPEL, WS-Coordination, WS-Policy, WS-Security, and J2EE support for SOA.

UNIT-I

Introduction to XML : XML document structure – Well formed and valid documents – Namespaces – DTD – XML Schema X-Files.

UNIT-II

Building XML- Based Application Parsing XML – using DOM, SAX – XML Transformation and XSL – XSL Formatting – Modeling Databases in XML.

UNIT-III

Service oriented Architecture Characteristics of SOA, Comparing SOA with Client-Server and Distributed architectures – Benefits of SOA -- Principles of Service orientation – Service layers.

UNIT-IV

Web Services Service descriptions – WSDL – Messaging with SOAP – Service discovery – UDDI – Message Exchange Patterns – Orchestration – Choreography –WS Transactions.

UNIT-V

Building SOA-Based Application Service Oriented Analysis and Design – Service Modeling – Design standards and guidelines - Composition – WS-BPEL – WS-Coordination – WSPolicy – WS-Security – SOA support in J2EE.

Text Book(s):

1. *Ron Schmelzer, Travis Vandersypen, Jason Bloomberg, Madhu Siddalingaiah, Sam Hunting, Michael Qualls, Chad Darby, David Houlding, Diane Kennedy - XML and Web Services, Pearson Education, 2002.*
2. *Thomas Erl ―Service Oriented Architecture: Concepts, Technology, and Design‖, Pearson Education 2008.*

Reference(s):

1. *Frank P.Coyle, ―XML,Web Services and the Data Revolution‖, Pearson.*
2. *Eric Newcomer, Greg Lomow, ― Understanding SOA with Web Services, Pearson.*
3. *Sandeep Chatterjee and James Webber, ―Developing Enterprise Web Services: An Architect's Guide‖, Prentice Hall.*
4. *James McGovern, Sameer Tyagi, Michael E.Stevens, Sunil Mathew, Java Web Services Architecture‖, Morgan Kaufmann Publishers 2010.*

e- Resources:

1. *Service-Oriented Architecture, Kenny Wong, University of Alberta - https://www.coursera.org/learn/service-oriented-architecture*

Course Code	Course Title						Core/Elective
U21PE515DS	Game Development						Elective
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
Computer Graphics, Software Engineering, Mathematics	3	-	-	-	30	70	3

Course Objectives:

The student should be made to:

1. Understand the concepts of Game design and development.
2. Learn the processes, mechanics and issues in Game Design.
3. Be exposed to the Core architectures of Game Programming.
4. Know about Game programming platforms, frame works and engines.
5. Learn to develop interactive games.

Course Outcomes:

Upon completion of the course, students will be able to:

1. Discuss the concepts of Game design and development.
2. Design the processes and use mechanics for game development.
3. Explain the Core architectures of Game Programming.
4. Use Game programming platforms, frame works and engines.
5. Create interactive Games.

UNIT-I

Graphics for Game Programming :Coordinate Systems, Ray Tracing, Modeling in Game Production, Vertex Processing, Rasterization, Fragment Processing and Output Merging, Illumination and Shaders, Parametric Curves and Surfaces, Shader Models, Image Texturing, Bump Mapping, Advanced Texturing, Character Animation, Physics-based Simulation.

UNIT-II

Gaming Engine Design: Game engine architecture, Engine support systems, Resources and File systems, Game loop and real-time simulation, Human Interface devices, Collision and rigid body dynamics, Game profiling

UNIT-III

Game Programming : Application layer, Game logic, Game views, managing memory, controlling the main loop, loading and caching game data, User Interface management, Game event management.

UNIT-IV

Gaming Platforms and Frameworks: Flash, DirectX, OpenGL, Java, Python, XNA with Visual Studio, Mobile Gaming for the Android, iOS, Game engines - Adventure Game Studio, DX Studio, Blender, Unity.

UNIT-V

Game Development: Developing 2D and 3D interactive games using OpenGL, DirectX – Isometric and Tile Based Games, Puzzle games, Single Player games, Multi-player games.

Text Books:

1. *Mike Mc Shaffrfy and David Graham, "Game Coding Complete", Fourth Edition, Cengage Learning, PTR, 2012.*

Reference Books:

1. *Jason Gregory, "Game Engine Architecture", CRC Press / A K Peters, 2009.*
2. *David H. Eberly, "3D Game Engine Design, Second Edition: A Practical Approach to Real-Time Computer Graphics" 2 nd Editions, Morgan Kaufmann, 2006.*

e-Resources:

Diploma in 3D Game Development With Unity Engine, Alison - https://alison.com/course/diploma-in-3d-game-development-with-unity-engine

Course Code	Course Title						Core/ Elective
U22PCN81CB	Web Technologies Lab						Core
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
OS, CN, OOP		-	-	2	25	50	1

Course Objectives:

1. Build static websites with HTML and CSS, and create interactive forms.
2. Develop dynamic web applications using JavaScript for validation and event handling.
3. Master server-side programming with Node.js, focusing on Express.js and MVC architecture.
4. Learn React.js for building interactive user interfaces with components and routing.
5. Integrate MongoDB with Node.js and React.js to develop a full-stack MERN application.

Course Outcomes: On completion of this course, the student will be able to-

1. Analyze a web page and identify its elements and attributes.
2. Apply Cascading Style Sheets web pages for a good aesthetic sense of design.
3. Build dynamic web pages using JavaScript.
4. Develop server-side scripting using Middleware Technologies for various application scenarios
5. Facilitate back-end Database communication for users via Middleware Technologies

List of Experiments:

1. Static Website Development
   - A. Create a static website using HTML tables.
   - B. Create a registration form using HTML forms.
   - C. Apply various CSS attributes and styles.

2. Dynamic Website Development
   - A. Develop dynamic Web content using JavaScript.
   - B. Develop a student registration form with Validation support using JavaScript.
   - C. Develop a dynamic website using JavaScript Event Handling
   - D. Develop DOM manipulation using JavaScript

3. Server-side programming using Node.js
   - A. Deployment of Node.js and built-in Node.js modules
   - B. Implement file system in Node.js
   - C. Introduction to Express.js, Router
   - D. Request Parameter handling, Request Response Objects
   - E. Develop MVC Architecture

4. Server-side programming using React.js
    A. Introduction to React Components, rendering HTML, JSX
    B. Execute React props, events, lists, forms, and router

5. MongoDB and React JS
    A. Essentials of No-SQL database
    B. Creating collections, retrieving data, inserting, updating, and querying the databases
    C. Connection with Node.js

6. CASE STUDY: A full-fledged MERN stack application

Suggested Tools*: VSCode, NodeJS (NPM: Express, EJS), Glitch, MongoDB community server or MongoDB Atlas*

Course Code	Course Title						Core/ Elective
U21PCN84CS	Operating Systems Lab						Core
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
Good knowledge of C, Computer Organization and Architecture, Data Structures	-	-	-	2	25	50	1

Course Objectives:

1. Learn different types of CPU scheduling algorithms
2. Demonstrate the usage of semaphores for solving synchronization problem
3. Understand memory management techniques and different types of fragmentation that occur in them and various page replacement policies
4. Understand Banker's algorithm used for deadlock avoidance
5. Learn various disk scheduling algorithms.

Course Outcomes:

After completing this course, the student will be able to:

1. Use different system calls for writing application programs.
2. Evaluate the performance of different types of CPU scheduling algorithms.
3. Implement producer-consumer problem, reader-writers problem, Dining philosopher's problem.
4. Simulate Banker's algorithm for deadlock avoidance.
5. Implement paging replacement and disk scheduling techniques

II. List of Experiments (preferred programming language is C)

1. Write a C programs to implement UNIX system calls and file management
2. Write C programs to demonstrate various process related concepts.
3. Write C programs to demonstrate various thread related concepts.
4. Write C programs to simulate CPU scheduling algorithms: FCFS, SJF, Round Robin
5. Write C programs to simulate Intra & Inter-Process Communication (IPC) techniques: Pipes, Messages Queues, Shared Memory.
6. Write C programs to simulate solutions to Classical Process Synchronization Problems: Dining Philosophers, Producer-Consumer, Readers-Writers.
7. Write a C program to simulate Bankers Algorithm for Deadlock Avoidance.
8. Write C programs to simulate Page Replacement Algorithms: FIFO, LRU.
9. Write C programs to simulate implementation of Disk Scheduling Algorithms: FCFS, SSTF.

Suggested tools: *Unix/Linux-based OS, GNU C compiler*

Course Code	Course Title						Core/ Elective
U22PC581CB	**Cyber Security Lab**						Core
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
Network security, operating system	-	-	-	2	25	50	1

Course Objectives:

1. Develop practical skills in identifying and mitigating common cyber security threats through hands-on exercises.
2. Understand the tools and techniques used in ethical hacking and penetration testing to secure digital assets.
3. Apply cryptographic principles to safeguard data confidentiality, integrity, and authenticity.
4. Learn to analyze malware behavior and implement defenses against various types of cyber attacks.
5. Gain proficiency in incident response and forensic investigation to effectively handle security breaches.

Course Outcomes:

After completing this course, the student will be able to:

1. Demonstrate proficiency in identifying and mitigating social engineering attacks such as phishing and ransomware through practical simulations.
2. Configure and manage virtualized environments by installing Kali Linux in a Virtual Machine, ensuring secure penetration testing and ethical hacking practices.
3. Implement robust security measures through understanding and application of Authentication, Authorization, and Accounting (AAA) principles in network environments.
4. Utilize advanced password cracking techniques with tools like Air cracking, John the Ripper, and Hydra to assess and strengthen password security protocols.
5. Analyze and respond to network threats by effectively using tools like NMAP, SNORT, and Grabber to detect vulnerabilities and secure systems against potential exploits

List of Experiments:

1. Explore Social Engineering Techniques: Phishing, Ransomware.
2. Install a Virtual Machine on a Computer: Installing Kali Linux in VM.
3. Authentication, Authorization, and Accounting.
4. Password Cracking: Aircrack, John the Ripper & Hydra.
5. Detecting Threats and Vulnerabilities: NMAP, SNORT, Grabber(Website)

6. Steganography: Using Steghide to Verify & Extract Hidden Files
7. Digital Signatures: Signing, Verification, Response Signature.
8. Network Analysis: Wireshark to Compare Telnet and SSH Traffic.
9. Perform open-source intelligence gathering using NETCRAFT and WHOIS.
10. Injection Attacks: SQLMAP, JSQL.

Suggested Tools:
Kali Linux, Parrot Linux, NMAP, AirCrack, John the Ripper, Hydra, Steghide, Wire-Shark, SNORT, MySQL community server

Course Code	Course Title						Core/ Elective
U22PW581CB	Mini-Project						Core
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
Programming Languages	-	-	-	4	25	50	2

Course Objectives:

1. Develop an application in the relevant area of Computer Science and allied courses.
2. Learn Contemporary tools and technologies
3. Expose the students to industry practices and teamwork.
4. Encourage students to work with innovative and entrepreneurial ideas.
5. Familiarize students with all the aspects of technical documentation.

Course Outcomes:

After completing this course, the student will be able to:

1. Evaluate different solutions based on economic and technical feasibility.
2. Effectively plan a project and confidently perform all aspects of SDLC.
3. Design a model to address the proposed problem.
4. Adapt to contemporary technologies.
5. Demonstrate the work done in the project through presentation and documentation.

Students are required to use emerging tools and technologies of CSE to solve a real-world problem in the various domains of Banking & Finance, Customer Relationship Management, Defense, Education, Environment & Sustainability, Government-related Applications, Healthcare, Humanities, Sports, Travel & Tourism and Transport etc.

A group of 2-3 students are formed as a team, and a faculty member is assigned to mentor the team. A problem statement which is relevant to the current trends must be formulated with clear scope and deliverables.

Team must build and demonstrate a software-based application adopting all the phases of software development lifecycle. Students must acquire the skills necessary to work as a team and to effectively present the project orally and in the form of a document. Students are required to submit a report and PPT on the project at the end of the semester.

The department will appoint a project coordinator who will coordinate the following:

1. Grouping of students (maximum of 3 students in a group)
2. Allotment of projects and project guides. Project allotments to be completed by the 3rd week of the semester so that the students get sufficient time for completion of the project.
3. Disseminate guidelines given by monitoring committee comprising of senior faculty members to the students and their guides.
4. Sessional marks to be awarded by the monitoring committee.

R21-BE CSE (IoT-CS-BcT) SEMESTER-VI

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			
			L	T	Pr/ Drg	Contact Hrs/ week	CIE	SEE	Duration of SEE (Hrs.)	Credits
Theory Courses										
1	U22PCN01AL	Distributed Systems and Cloud Computing	3	-	-	3	30	70	3	3
2	U21PC602CS	Artificial Intelligence and Machine learning	3	-	-	3	30	70	3	3
3	U22PC601CB	Cryptography and Network Security	3	-	-	3	30	70	3	3
4	U22PE62XXX	Professional Elective – II	3	-	-	3	30	70	3	3
5	U22PE63XXX	Professional Elective – III	3	-	-	3	30	70	3	3
6	U21OE61XXX	Open Elective – I	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
7	U22PCN81AL	Distributed Systems and Cloud Computing Lab	-	-	2	2	25	50	3	1
8	U21PC682CS	Artificial Intelligence and Machine learning Lab	-	-	4	4	25	50	3	2
9	U22PC683AL	DevOps Lab	-	-	4	4	25	50	3	2
*Summer Internship(U22PW782CB):To be conducted after VI Semester in Summer Vacation and to be evaluated in VII Semester										
		Total	**18**	**-**	**10**	**28**	**255**	**570**	**27**	**23**

Professional Elective – II		
S.No	**Course Code**	**Course Title**
1	U22PE621DS	Object Oriented System Development
2	U22PE622AL	Mobile Application Development
3	U22PE623CB	Wireless Sensor Networks
4	U22PE624CB	Web 3.0
5	U22PE625CB	Fundamentals of Data Science

Professional Elective – III		
S.No.	**Code**	**Course Title**
1	U22PE631DS	Human Computer Interaction
2	U22PE632CB	Software Project Management
3	U22PE633AL	Introduction to Robotics
4	U22PE634CB	Crypto Currencies
5	U22PE635CB	Natural Language Processing

Open Elective –I		
S.No.	**Code**	**Course Title**
1	U21OE611AE	Automobile Engineering
2	U21OE611CE	Disaster Mitigation
3	U21OE611CS	Fundamentals of Data Structures
4	U21OE611EC	Principles of Electronic Communications
5	U21OE612EC	Electronic Instrumentation
6	U21OE611EE	Electrical Energy Conservation and Safety
7	U21OE611IT	Database Systems
8	U21OE611ME	Operations Research & Techniques
9	U21OE612ME	Industrial Robotics
10	U21OE611EG	Soft skills and Interpersonal Skills

Course Code	Course Title						Core/Elective
U22PCN01AL	Distributed Systems and Cloud Computing						Core
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
Operating systems Web technologies	3	-	-	-	30	70	3

Course Objectives: This course aims to

1. To learn about the concepts of distributed systems.
2. To understand distributed resource management.
3. To study the basics of cloud computing.
4. To study about virtualization and cloud resource management.
5. To be aware of different cloud platforms.

Course Outcomes:

After completing this course, the student will be able to:

1. Designing and evaluation of algorithms and protocols for various distributed systems.
2. Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
3. Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.
4. Explain the core issues of cloud computing such as resource management and security.
5. Choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.

UNIT-I

Introduction: Introduction to distributed systems and cloud computing, Design goals – Transparency Issues of distributed systems and cloud computing, Internet and Distributed Computing, Cloud Deployment Models, Cloud Delivery Models: SaaS, PaaS, IaaS.

System Architectures, Architectures versus Middleware, Cloud Computing architectures, End-to-end system design. Threads, Virtualization and types, Code Migration. Networks and protocol stacks,. Client-server computing. Sockets and remote procedure call, Remote Method Invocation, Multicast Communication.

UNIT-II

Infrastructure And Storage Mechanism: Data in Cloud, Database Technology: CDN,The CAP Theorem, NoSQL data stores, Distributed hash tables. Table -based (Google BigTable), key-based (Amazon Dynamo), and Cassandra. Storage in the Cloud: Google, Hadoop file system., Load Balancer, SLA Monitor, Hypervisor, Resource Cluster, Clusters and Supercomputers, Multi Device Broker.

Naming and Synchronization: Naming, DNS, Resolution Techniques**,** Clock Synchronization, Distributed snapshots, Distributed debugging. Logical Clocks, Time and ordering of events. Global Positioning of nodes, Election Algorithms, Mutual Exclusion Algorithms, Causal broadcasts.

UNIT-III

Consistency and Replication: Introduction, Data-Centric Consistency Models, Client-Centric Consistency Models, Replica Management, and Consistency Protocols. and cache consistency.

Fault Tolerance: Introduction to Fault Tolerance, Failure models and failure detectors, Process Resilience, Replicated services and quorum consensus, Consensus and the Paxos algorithm, Reliable Client- Server Communication, Reliable Group Communication,

Transactions: Serializability and recoverability. Long-lived transactions. Atomic commitment protocols:2PC and 3PC. Distributed Commit, and Recovery.

Distributed Object-Based Systems: CORBA, DCOM, GLOBE -Architecture, Comparison

UNIT-IV

File Systems: Introduction, Goals, Distributed file systems :SUN-NFS, AFS. CODA, Cloud file systems : Google/Hadoop file system, Examples,

Web-Based Systems: Traditional Web-Based Systems, Web Services Fundamentals, The Apache Web Server, Web Server Clusters, Communication, HTTP Fundamentals, Web services and REST. Example: Amazon S3. The JAX-RS API , Persistent cloud services & Server-side events and REST. Web sockets. Vert.x: Node.js for Java, SOAP, SLA Management System, Web Proxy Caching, Replication for Web Hosting Systems-CDN'S**,** Service-Oriented Architectures,

UNIT-V

Cloud Application Development: Amazon Web Services:Ec2 Cloud Application, How to install Hadoop in Eclipse on Windows system, Cloud Based simulation of a distributed Trust algorithm**,** Apache Hadoop Amazon Elastic, Batch cloud computing: Map-Reduce: Example, Scaling, Programming Model, Mapreduce.net and Hadoop. Domain-specific languages for cloud data processing: Pig and Hive.

Applications in the cloud: Google App Engine(GAE) Amazon Web Services(AWS)– Cloud Software Environments – Eucalyptus – Open Nebula – Open Stack Google Chubby, Yahoo Zookeeper, Peer-to-peer systems. Applications in multiplayer game-playing, Highly available services. The Hector API. Query processing with Map-reduce.

Security Reference Model: Public Key Infrastructure, Identity and Access Management. Data Security :Application Security –Virtual Machine Security .

Text Books:

1. *Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra, "Distributed and Cloud Computing from Parallel Processing to the Internet of Things", Elsevier, 2012***.**
2. *Dominic Duggan , Enterprise Software Architecture and Design .*
3. *Cloud Computing - Sandeep Bhowmik, Cambridge University Press, 2017.*
4. *Enterprise Cloud Computing - Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2016.*
5. *Distributed Computing, Sunita Mahajan and Seema Shah, Oxford University*
6. *Andrew S. Tanenbaum and Maarten Van Steen, Distributed Systems, PHI 2nd Edition, 2009.3*
7. *Distributed Computing, Fundamentals, Simulations and Advanced topics, 2nd Edition, HagitAttiya and Jennifer Welch, Wiley India*
8. *Distributed Systems: Concepts and Design, G. Coulouris, J. Dollimore, and T. Kindberg.*
9 *Andrew S. Tanenbaum and Maarten Van Steen, Distributed Systems, PHI 4th Edition, 2023, ISSN - 978-9081540636*

Reference Books:

1. *Toby Velte, Anthony Velte, Robert C. Elsenpeter, ―Cloud Computing, A Practical Approach‖, Tata McGraw-Hill Edition, 2010.*
2. *Rittinghouse, John W., and James F. Ransome, "Cloud Computing: Implementation, Management, And Security", CRC Press, 2017.*
3. *R. Hill,L. Hirsch,P.Lake,S.Moshiri, Guide to Cloud Computing,Principles andPractice‖, Springer, 2013.*
4. *R. Buyya, J. Borberg, A. Goscinski, Cloud Computing-Principles and Paradigms, Wiley,2013.*
5. *Distributed Operating Systems by P. K. Sinha, PHI 2010.*
6. *Distributed Systems: Principles and Paradigms, Taunenbaum, 2012.*
7. *Java Network Programming &Distributed Computing by David Reilly, Michael Reill,2013.*

e-Resources:

1. *Cloud Computing and Distributed Systems, IIT Patna, Dr.Rajiv Misra - https://nptel.ac.in/courses/106104182*

Course Code	Course Title						Core/ Elective
U21PC602CS	**Artificial Intelligence and Machine Learning**						Core
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
Data Structures, Linear algebra, Probability and Statistics	3	-	-	-	30	70	3

Course Objectives:

1. Understand the importance of AI & ML, history and various applications.
2. Learn about one of the basic applications of A.I, search state formulations.
3. Learn methods of expressing knowledge by a machine with appropriate reasoning and how to reason when an agent has only uncertain information about its task.
4. Know various supervised and unsupervised learning algorithms.
5. Explore basics of neural networks

Course Outcomes:

On completion of this course, the student will be able to-

1. Formalize a problem in the language/framework of different AI and ML methods
2. Illustrate basic principles of AI in solutions that require problem solving, search, inference
3. Represent natural language/English using Predicate Logic to build knowledge through various representation mechanisms
4. Demonstrate understanding of steps involved in building of intelligent agents, expert systems, Bayesian networks
5. Differentiate between learning paradigms to be applied for an application and apply relevant supervised/unsupervised algorithms.

UNIT-I

Introduction- What is intelligence? Foundations of artificial intelligence (AI). History of AI, Structure of Agents.

Problem Solving - Formulating problems, problem types, states and operators, state space.

Search strategies - Informed Search Strategies- Best first search, A* algorithm, heuristic functions, Iterative deepening A*.

Adversarial Search/ Game playing - Perfect decision game, imperfect decision game, evaluation function, alpha-beta pruning.

UNIT-II

Reasoning - Knowledge based agent, Propositional Logic, Inference, Predicate logic (first order logic), Resolution.

Expert System and Applications: Introduction, Phases in Building Expert Systems, Expert System

Architecture, Applications.
Uncertainty - Basic probability, Bayes rule, Belief networks, Inference in Bayesian Networks.

UNIT-III
Supervised learning
Types of Machine-Learning Algorithms: Parametric and Nonparametric, Supervised, Unsupervised, Semi Supervised and Reinforcement Learning.
Regression: Least squares, Single variable cost function, gradient descent for linear regression.
Logistic regression: Discriminative Classification, Hypothesis Representation, Decision Boundary, Cost function.
Classification: Naive Bayes, Decision Tree, K-Nearest Neighbors, Support vector machine.

UNIT-IV
Neural Networks: Perceptron, Multilayer neural network, activation functions, network training – gradient descent optimization, back propagation.
Evaluation: SSE, RMSE, S2, Confusion matrix, Accuracy, Precision, Recall, F-score, ROC, cross-validation, hold -out.

UNIT-V
Unsupervised learning: Similarity measures, K-means, Hierarchical, Gaussian mixture models, and Expectation maximization.
Reinforcement Learning: State and Action spaces, Learning from rewards, Action Selection, Policy, Active and Passive reinforcement Learning, Applications.
Applications: NLP - Text classification, Sentiment analysis, Computer Vision – Image classification, Object Recognition Speech – Speech recognition.

Text Books:

1. *Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", Fourth Edition, Pearson Education, 2021.*
2. *Machine learning, T. Mitchell., McGraw-Hill New York, (1997).*
3. *Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition.*

References:

1. *Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2011.*
2. *Trevor Hastie Robert Tibshirani Jerome Friedman, The Elements of Statistical Learning, Data Mining, Inference, and Prediction, Springer Series in Statistics, 2009.*
3. *Saroj Kaushik, Artificial Intelligence, Cengage Learning, 1st Edition, 2011.*
4. *Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008.*
5. *Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013.*

e-Resources:
1. *Artificial Intelligence, IIT Kharagpur, Prof. Anupam Basu, Prof. S. Sarkar - https://nptel.ac.in/courses/106105077*
2. *Machine Learning,ML, KTH Royal Institute of Technology, Sweden, Prof. Carl Gustaf Jansson - https://nptel.ac.in/courses/106106202*

Course Code	Course Title						Core/ Elective
U22PC601CB	Cryptography and Network Security						Core
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
Engg. Math., DAA, CN	3	-	-	-	30	70	3

Course Objectives:

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

1. Describe the significance and practical uses of confidentiality, integrity, authenticity, and availability.
2. Understand the various cryptographic algorithms.
3. Understand the basic categories of threats to computers and networks
4. Describe the enhancements made to IPv4 by IPSec.
5. Develop Network Security skills.

Course Outcomes:

On completion of this course, the student will be able to-

1. Understand fundamental concepts of cryptography and network security.
2. Apply cryptographic algorithms to secure communication
3. Analyze network traffic to identify potential security threats
4. Evaluate the effectiveness of different security protocols and cryptographic techniques
5. Develop Security Strategies.

UNIT-I

Security Concepts: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security Cryptography Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography, key range and key size, possible types of attacks.

UNIT-II

Symmetric key Ciphers: Block Cipher principles, DES, AES, Blowfish, RC5, IDEA, Block cipher operation, Stream ciphers, RC4. Asymmetric key Ciphers: Principles of public key cryptosystems, RSA algorithm, Elgamal All Cryptography, Diffie-Hellman Key Exchange, Knapsack Algorithm.

UNIT-III

Cryptographic Hash Functions: Message Authentication, Secure Hash Algorithm (SHA512), Message authentication codes: Authentication requirements, HMAC, CMAC, Digital signatures, Elgamal Digital

Signature Scheme. Key Management and Distribution: Symmetric Key Distribution Using Symmetric & Asymmetric Encryption, Distribution of Public Keys, Kerberos, X.509 Authentication Service, Public – Key Infrastructure

UNIT-IV

Transport-level Security: Web security considerations, Secure Socket Layer and Transport Layer Security, HTTPS, Secure Shell (SSH) Wireless Network Security: Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN, IEEE 802.11i Wireless LAN Security

UNIT-V

E-Mail Security: Pretty Good Privacy, S/MIME IP Security: IP Security overview, IP Security architecture, Authentication Header, Encapsulating security payload, Combining security associations, Internet Key Exchange Case Studies on Cryptography and security: Secure Multiparty Calculation, Virtual Elections, Single sign On, Secure Inter-branch Payment Transactions, Cross site Scripting Vulnerability.

Text Books:

1. *Cryptography and Network Security - Principles and Practice: William Stallings, Pearson Education, 6th Edition*
2. *Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition*

Reference Books:

1. *Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1st Edition.*
2. *Cryptography and Network Security : Forouzan Mukhopadhyay, Mc Graw Hill, 3rd Edition.*
3. *Information Security, Principles, and Practice: Mark Stamp, Wiley India.*
4. *Principles of Computer Security: WM. Arthur Conklin, Greg White, TMH 5. Introduction to Network Security: Neal Krawetz, CENGAGE Learning 6. Network Security and Cryptography: Bernard Menezes, CENGAGE Learning.*

e-Resources:

1. *Cryptography And Network Security, IIT Kharagpur, Prof. Sourav Mukhopadhyay - https://nptel.ac.in/courses/106105162*

PROFESSIONAL ELECTIVE-II

Course Code	Course Title						Core/Elective
U22PE621DS	Object Oriented System Development						Elective
	Contact Hours per week						
Prerequisite	L	T	D	P	CIE	SEE	Credits
Software Engineering	3	-	-	-	30	70	3

Course Objectives:

1. The essentials and fundamental aspects of object-oriented concepts along with their applications
2. To analyze, design and implement object-oriented software systems by means of a mid- sized project.
3. Learn software development life cycle for Object-Oriented solutions for Real-World Problems.
4. Exposure to various modeling techniques to model different perspectives of object- oriented software design (UML).
5. Application of software architectures in various settings, including the application of design patterns, frameworks and toolkits

Course Outcomes:

On completion of this course, the student will be able to-

1. Master UML basics including classes, relationships, and class diagrams.
2. Proficiency in interactions, use cases, and activity diagrams for system behavior modeling.
3. Expertise in artifacts, deployments, and architectural patterns/frameworks through diagrams.
4. Apply the Unified Process with a use-case driven approach to software development.
5. Execute core workflows from requirements capture to implementation and testing using use case analysis and design methodologies.

UNIT-I

U M L Introduction: Intro to Model and UML, Basic Modeling Classes, Relationships, Common mechanism, Diagrams, Class Diagrams.

UNIT-II

Basic Behavioral Modeling: Interactions, Use Cases, Use Case Diagrams, Interaction Diagrams, Activity Diagrams.

UNIT-III

Architectural Modeling: Artifacts, Deployment Collaborations, Patterns and Frameworks, Artifact diagrams, Deployment diagrams, Systems and models.

UNIT-IV

Unified Software Development Process: The Unified process, The Four Ps, A use-case – Driven Process.

UNIT-V

Core Workflows: Requirements Capture, Capturing Requirements as Use Cases, Analysis, Design, Implementation, and Test.

Text Books:

1. *"The Unified Modeling Language – User Guide" by Grady Booch, James Rumbaugh, Icor Jacobson.*

Reference Books:

1. *Object Management Group(OMG) - The Unified Modeling Language Specification Version 2.5.1, December 2017 –*
2. *https://www.omg.org/spec/UML, https://www.omg.org/spec/UML/2.5.1/PDF (OMG Doc.No.formal/2017-12-05)*

e-Resources:

Object Oriented System Development using UML, Java and Patterns, IIT Kharagpur, Prof. Rajib Mall - https://nptel.ac.in/courses/106105224

Course Code	Course Title						Core/ Elective
U22PE622AL	**Mobile Application Development**						Elective
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
OOP, OS, DBMS	3	-	-	-	30	70	3

Course Objectives:

1. To facilitate students to understand mobile application SDK.
2. To help students gain basic understanding of mobile application development.
3. To inculcate students with working knowledge of mobile application development tools.
4. To make students understand the importance of intents for activity communication and broadcast receivers.
5. To comprehend students with the integration of SQLite databases into mobile application development.

Course Outcomes:

On completion of this course, the student will be able to-

1. Analyze architecture of android and current trends in mobile operating systems.
2. Design basic mobile applications incorporating various UI elements.
3. Demonstrate the knowledge to create, manipulate and interface fragments
4. Apply intents and broadcast receivers in android application.
5. Develop applications for mobile devices using SQLite Database.

UNIT-I

Introduction to Android Operating System: Android OS and Features – Android development framework; Installing and running applications on Android Studio, Creating AVDs, Types of Android application; Creating Activities, Activity Life Cycle, Activity states, monitoring state changes

UNIT-II

Android application components – Android Manifest file, externalizing recourses like Simple Values, Drawables, Layouts, Menus, etc,

Building User Interfaces: Fundamental Android UI design, Layouts – Linear, Relative, Grid and Table Layouts. User Interface (UI) Components

UNIT-III

Fragments – Creating fragments, Lifecycle of fragments, Fragment states, Adding fragments to Activity, adding, removing and replacing fragments with fragment transactions, interfacing between fragments and activities

UNIT-IV

Intents and Broadcasts: Using intents to launch Activities, Types of Intents, Passing data to Intents, Getting results from Activities, Broadcast Receivers – Using Intent filters to service implicit Intents, Resolving Intent filters

UNIT-V

Database: Introduction to SQLite database, creating and opening a database, creating tables, inserting retrieving and deleting data

Text Books:

1. *Professional Android Application Development, Reto Meier, Wiley India, (Wrox)*
2. *Android Application Development for Java Programmers, James C Sheusi, Cengage Learning*

Reference(s):

1. *Beginning Android Application Development, Wei-Meng Lee, Wiley India (Wrox)*
2. *Android Application Development, Black Book, Pradeep Kothari, Dreamtech Press*
3. *Android Programming: Pushing the Limits, Erik Hellman, Wiley Publications*
4. *Suggested MOOCs/Value Added Course(s): https://developer.android.com/courses*

e-Resources:

1. *Mobile Computing, IIIT Delhi, Prof.Sridhar Iyer, Prof. Pushpendra Singh - https://nptel.ac.in/courses/106106147*

Course Code	Course Title						Core/ Elective
U22PE623CB	Wireless Sensor Networks						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Data Communications and Computer Networks.	3	-	-	-	30	70	3

Course Objectives:

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

1. Understand the concept of wireless sensor networks, design and implementation issues and available solutions.
2. Demonstrate the routing mechanisms.
3. Understand the clustering mechanisms and different schemes that have been employed, e.g., hierarchical.
4. Explain sensor networks and their characteristics. This includes design of MAC layer protocols, understanding of power management, query processing, and sensor databases.
5. Demonstrate the designing and implementing wireless sensor network functionality using network simulation tools and Pocket PCs.

Course Outcomes:

After completion of this course students will be able to

1. Understand characteristics of WSN, design issues and applications.
2. Classify WSNs, and understand different routing algorithms.
3. Demonstrate secure routing using key management techniques.
4. Identify challenges in sensor network programming to develop sensor network platforms and tools.
5. Create programs for Tiny OS, node level simulators using using nesC and TinyGALS.

UNIT-I

Basics of Wireless Sensors and Applications: The Mica Mote, Sensing and Communication Range, Design Issues, Energy Consumption, Clustering of Sensors, Applications.

UNIT-II

Data Retrieval In Sensor Networks: Classification of WSNs, MAC Layer, Routing Layer, High-Level Application Layer Support, Adapting to the Inherent Dynamic Nature of WSNs.

UNIT-III

Security: Security in Wireless Networks, Key Management, Secure Routing, Intrusion Detection Systems

UNIT-IV

Sensor Network Platforms and Tools: Sensor network Hardware, Sensor Network Programming Challenges, and Node-Level Software Platforms.

UNIT-V

Operating System-Tiny OS: Imperative Language: nesC, Data flow style language: TinyGALS, Node-Level Simulators, NS-2 and its sensors network extension, TOSSIM.

Text Books:

1. *Ad Hoc and Sensor Networks: Theory and Applications, Carlos de Morais Cordeiro and Dharma Prakash Agrawal, World Scientific Publications / Cambridge University Press,2006.*
2. *Wireless Sensor Networks: An Information Processing Approach, Feng Zhao, Leonidas Guibas, Elsevier Science Imprint, Morgan Kauffman Publishers, 2005.*

References:

1. *Ad Hoc Wireless Networks: Architectures and Protocols, C. Siva Ram Murthy and B. S. Manoj, Pearson Education, 2004.*
2. *Guide to Wireless Ad Hoc Networks, Sudip Misra, Isaac Woungang, and Subhas Chandra Misra, Springer International Edition, 2011.*
3. *Guide to Wireless Sensor Networks, Sudip Misra, Isaac Woungang, and Subhas Chandra Misra, Springer International Edition, 2012.*
4. *Wireless Mesh Networking, Thomas Krag and Sebastin Buettrich, O'Reilly Publishers,2007.*
5. *Wireless Sensor Networks – Principles and Practice, Fei Hu, Xiaojun Cao, An Auerbach book, CRC Press, Taylor & Francis Group, 2010.*
6. *Wireless Ad hoc Mobile Wireless Networks-Principles, Protocols and Applications, Subir Kumar Sarkar, et al., Auerbach Publications, Taylor & Francis Group, 2008.*
7. *Wireless Ad hoc Networking, Shih-Lin Wu, Yu-Chee Tseng, Auerbach Publications, Taylor & Francis Group, 2007.*
8. *Wireless Ad hoc and Sensor Networks–Protocols, Performance and Control, Jagannathan Sarangapani, CRC Press, Taylor & Francis Group, 2007, rp2010.*
9. *Security in Ad hoc and Sensor Networks, Raheem Beyah, et al., World Scientific Publications /Cambridge University Press, 2010.*

e-Resources:

1. *Wireless Ad Hoc and Sensor Networks, IIT Kharagpur, Prof. Sudip Misra - https://nptel.ac.in/courses/106105160*

Course code	Course Title						Core/ Elective
U22PE624CB	Web 3.0						Elective
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
Web programming, Block chain basics	3	0	0	0	30	70	3

Course Objectives:

1. To introduce the concept of web 3.0 and its association with blockchain
2. To explore on key features of distributed ledgers, decentralized applications with web 3.0
3. To infer on Tokenization, NFT's, DeFi, ZKP's and web 3.0 browsers
4. To comprehend the role of blockchain in web 3.0
5. To understand various security challenges and applications of web 3.0

Course Outcomes:

At the end of the course Students will be able to

1. Understand the purpose, characteristics and the architecture of web 3.0
2. Compare the web 1.0,web 2.0 and web 3.0 in decentralized networks
3. Explain the concepts of NFT's and Tokenizations, web 3.0 browsers and ZKP's.
4. Familiarize with the concepts of metaverse BaaS and DAO
5. Understand the challenges and applications of web 3.0 though blockchain

UNIT-I

Introduction: The web's evolution, Web 3.0's key characteristics, Difference between Web 1.0 , Web 2.0 and Web 3.0, Overview of Web 1.0, Web 2.0, Layers and properties of Web 3.0, Web 3.0 architecture, DApps- a gateway to web 3.0, real-world examples of web 3.0, benefits and disadvantages of web 3.0

UNIT-II

Web 3.0 Key Features and Developments: Impact of DLT on web 3.0, examples of DLT, DApps and the power of smart contracts in web 3.0, enhancing Web 3.0 with DApps, Decentralization: definition, benefits,decentralized networks, governance models for decentralized networks, decentralized identity, decentralized storage and voting systems. interoperability

UNIT-III

Tokenization and NFT's: Tokenization in web 3.0, Examples of web 3.0 tokenization, NFT's: Definition, benefits of NFT;s in web 3.0, types of NFT's, Web 3.0 browsers, Zero-Knowledge proofs, DeFi, Privacy

UNIT-IV

Web 3.0 and Blockchain: The significance of Blockchain in web 3.0, Examples of blockchain in web 3.0, Blockchain-as-a-Service(BaaS) in web 3.0,DAO:Evolution,examples of DAO in web 3.0, Metaverse: Evolution, Examples, Metaverse opportunities, Web 3.0 and metaverse

UNIT-V

Applications of Web 3.0: Social media, E-commerce, Gaming, Incentive based DApps, Cloud computing and web 3.0,IoT and web 3.0, AI and web 3.0,use cases for AI

Challenges for Web 3.0: Technical challenges, Regulatory challenges, Adoption challenges

Textbooks:

1. *"WEB 3.0 - What Is Web3? Potential of Web 3.0 (Token Economy, Smart Contracts, DApps, NFTs, Blockchains, GameFi, DeFi, Decentralized Web, Binance, Metaverse Projects, Web3.0 Metaverse Crypto guide, Axie)" by Patrick Ejeke 2010.*
2. *"Web 3.0: The Future of Decentralized Technology and Its Impact on Society: A guide to navigate through the New [Decentralized] World of Web 3.0 and beyond", Shawn Chambers 2013.*

References:

1. *"Web 3.0: Concept, Content and Context" by Shenghui Cheng, Springer 2013.*
2. *"A Brief Introduction to Web3 Decentralized Web Fundamentals for App Development" by Shashank Mohan Jain, Apress,2023*

e-Resources:

1. *Introduction to Blockchain and Web3 by Web3 Foundation via edX - https://www.edx.org/learn/blockchain/web3-foundation-introduction-to-blockchain-and-web3*

Course Code	Course Title						Core/ Elective
U22PE625CB	Fundamentals of Data Science						Elective
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
Engg. Math.	3	-	-	-	30	70	3

Course Objectives:

1. Develop relevant programming abilities.
2. Demonstrate proficiency with statistical analysis of data.
3. Develop the ability to build and assess data-based models.
4. Execute statistical analyses with professional statistical software.
5. Apply data science concepts and methods to solve problems in real-world contexts and will communicate these solutions effectively

Course Outcomes:

At the end of the course, a student will be able to

1. Describe the significance of data science and understand the Data Science process. (L2)
2. Explain how data is collected, managed and stored for data science.(L2)
3. Build, and prepare data for use with a variety of statistical methods and models (L3)
4. Analyze Data using various Visualization techniques. (L4)
5. Choose contemporary models, such as machine learning, AI, techniques to solve practical problems (L4)

UNIT-I

Introduction To Data Science: Definition, Big Data and Data Science Hype, Datafication, Data Science Profile, Meta-Definition, Data Scientist, Statistical Inference, Populations and Samples, Populations and Samples of Big Data, Modeling, Exploratory Data Analysis, The Data Science Process

UNIT-II

Mathematical Preliminaries: Descriptive Statistics, Correlation Analysis.
Data Munging: Properties of Data, Languages for Data Science, Collecting Data, Cleaning Data.

UNIT-III

Scores and Rankings: Developing Scoring Systems, Z-scores and Normalization, Statistical Analysis: Sampling from Distributions, Statistical Distributions, Statistical Significance, Permutation Tests and P-values

UNIT-IV

Visualizing Data: Exploratory Data Analysis, Developing a Visualization Aesthetic, Chart Types, Great Visualizations

UNIT-V

Supervised Learning: Linear Regression, Better Regression Models, Regression as Parameter Fitting, Naive Bayes, Decision Trees Classifiers

Text Books:

1. *Steven S. Skiena, "The Data Science Design Manual", Springer 2017.*
2. *Rachel Schutt & O'neil, "Doing Data Science", Straight Talk from The Frontline O'REILLY, ISBN:978-1-449-35865-5, 1st edition, October 2013.*

Reference Books:

1. *Joel Grus," Data Science from Scratch" First Edition, April 2015*
2. *Gareth James, Daniela Witten, Trevor Hatie, RoberstTibhirani , "An Introduction to Statistical Learning-with Applications in R", 2013*
3. *Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2 edition (30 September 2014)*
4. *R Programming for Data Science, Roger D. Peng, LeanPub, 2015.*

e-Resources*:*

1. *"Data science for engineers" https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs28/*

PROFESSIONAL ELECTIVE –III

Course Code	Course Title						Core/ Elective
U22PE631DS	Human Computer Interaction						Elective
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
Software Engineering	3	-	-	-	30	70	3

Course Objectives:

1. Gain an overview of Human-Computer Interaction (HCI), with an understanding of user interface design in general, and alternatives to traditional "keyboard and mouse" computing
2. Become familiar with the vocabulary associated with sensory and cognitive systems as relevant to task performance by humans
3. Be able to apply models from cognitive psychology to predicting user performance in various human-computer interaction tasks and recognize the limits of human performance as they apply to computer operation
4. Appreciate the importance of a design and evaluation methodology that begins with and maintains a focus on the user.
5. Be familiar with a variety of both conventional and non-traditional user interface paradigms, the latter including virtual and augmented reality, mobile and wearable computing, and ubiquitous computing; and understand the social implications of technology and their ethical responsibilities as engineers in the design of technological systems.

Course Outcomes:

At the end of the course, a student will be able to

1. Explain the capabilities of both humans and computers from the viewpoint of human information processing.
2. Describe typical human–computer interaction (HCI) models, styles, and various historic HCI paradigms.
3. Apply an interactive design process and universal design principles to designing HCI systems.
4. Describe and use HCI design principles, standards and guidelines.
5. Analyze and identify user models, user support, socio-organizational issues, and stakeholder requirements of HCI systems.

UNIT-I

Introduction: Importance of user Interface – definition, importance of good design. Benefits of good design. A brief history of Screen design.

The graphical user interface – popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user – Interface popularity, characteristics- Principles of user interface.

UNIT-II

Design process – Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, understanding business junctions.

Screen Designing: Design goals – Screen planning and purpose, organizing screen elements, ordering of screen data and content – screen navigation and flow – Visually pleasing composition – amount of information – focus and emphasis – presentation information simply and meaningfully – information retrieval on web – statistical graphics – Technological consideration in interface design.

UNIT-III

Windows – New and Navigation schemes selection of window, selection of devices based and screen-based controls. Components – text and messages, Icons and increases – Multimedia, colors, uses problems, choosing colors.

UNIT-IV

HCI in the software process, The software life cycle Usability engineering Iterative design and prototyping Design Focus: Prototyping in practice Design rationale Design rules Principles to support usability Standards Golden rules and heuristics HCI patterns Evaluation techniques, Goals of evaluation, Evaluation through expert analysis, Evaluation through user participation, Choosing an evaluation method. Universal design, Universal design principles Multi-modal interaction

UNIT-V

Cognitive models Goal and task hierarchies Design Focus: GOMS saves money Linguistic models The challenge of display-based systems Physical and device models Cognitive architectures Ubiquitous computing and augmented realities Ubiquitous computing applications research Design Focus: Ambient Wood – augmenting the physical Virtual and augmented reality Design Focus: Shared experience Design Focus: Applications of augmented reality Information and data visualization Design Focus: Getting the size right.

Text Books:

1. *The essential guide to user interface design, Wilbert O Galitz, Wiley Dream Tech. Units 1, 2, 3*
2. *Human – Computer Interaction. Alan Dix, Janet Fincay, Gre Goryd, Abowd, Russell Bealg, Pearson Education Units 4,5*

Reference Books:

1. *Designing the user interface. 3rd Edition Ben Shneidermann, Pearson Education Asia,2010.*
2. *Interaction Design Prece, Rogers, Sharps. Wiley Dreamtech, 2011*
3. *User Interface Design, Soren Lauesen , Pearson Education.2013*
4. *Human –Computer Interaction, D. R. Olsen, Cengage Learning 2011.*
5. *Human –Computer Interaction, Smith - Atakan, Cengage Learning 2010*

e-Resources:

1. *Human-Computer Interaction, IIT Guwahati, Dr.Samit Bhattacharya, Pradeep P Yammiyavar - https://nptel.ac.in/courses/106103115*

Course Code	Course Title						Core/ Elective
U22PE632CB	Software Project Management						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Software Engineering	3		-	-	30	70	3

Course Objectives

1. To highlight the importance of software project management and understand the Software Project Planning and Evaluation techniques.
2. To discuss various processes in Software Project Management and manage projects at each stage of the software development life cycle.
3. To Provide Tools and Techniques for Project Monitoring and learn about the activity planning and risk management.
4. To expose different Project Management Lifecycles and manage software project deliverables.
5. To develop skills to manage the various phases involved in project management and people management.

Course Outcomes

Upon completion of the course, the students will be able to:

1. Design a project management plan using different project management lifecycles.
2. Acquire the ability to track project execution and knowledge about software effort estimation techniques.
3. Analyze the risks associated with the Projects and identify the checkpoints, project reporting structure, project progress and tracking mechanisms using project management principles.
4. Gain extensive knowledge about the basic project management concepts, framework and the process models.
5. Understand staff selection process and the issues related to people management.

UNIT-I

Conventional Software Management, Evolution of Software Economics, Improving Software Economics, Old Way & New.

UNIT-II

Life – Cycle phases, Artifacts of the process, Model Based Software Architectures, Workflows of the Process, Check points of the process.

UNIT-III

Iterative Process Planning, Project Organizations & Responsibilities, Process Automation, Project Control of Process Instrumentation, Tailoring the Process.

UNIT-IV
Modern Project profiles, Next Generation Software Economics, Modern process Transitions, Managing Contacts, Managing People & Organizing Terms.

UNIT-V
Process improvement & mapping to the CMM, ISO 12207 – an overview, programme management.

Text Books:

1. *Walker Royce, Software Project Management – A Unified frame work, Pearson Education, Addison, 1998, Sixth Printing November 2000*

Reference Books:

1. *Bob Hughes and Mike Cotterell, Software Project Management, Tata McGraw Hill, 3rd Edition, 2010.*
2. *Watt.S. Humphery, Managing Software Process, Addison - Wesley, 2008.*

e-Resources:

1. *Software Project Management, IIT Kharagpur, Prof. Rajib Mall, Prof. Durga Prasad Mohapatra - https://nptel.ac.in/courses/106105218*

Course Code	Course Title						Core/ Elective
U22PE633AL	Introduction to Robotics						Elective
Prerequisite	Contact Hour s per Week				CIE	SEE	Credits
	L	T	D	P			
BE&S, CO, IoT	3		-	-	30	70	3

Course Objectives:

1. To acquire knowledge on fundamental concepts of Robotics.
2. To have knowledge on Robotic programming
3. To understand Sensors and Perception.
4. To have knowledge on Robot Control Systems
5. To understand Applications of Robotics:

Course Outcomes

1. Upon completion of the course, the students will be able :
2. To understand the analytical skills.
3. To Analyze Analytical skills
4. To Apply Practical application
5. To Analyze Problem solving abilities.

UNIT-I

Framework for Thinking About AI and Robotics: Intelligent Robot, Components of a Robot. Three Modalities, Kinds of Robots. Motivation. Seven Areas of AI.

Automation and Autonomy: Overview. The Four Sliders of Autonomous Capabilities. Bounded Rationality. Impact of Automation and Autonomy. Impact on Programming Style. Impact on Hardware Design. Impact on Types of Functional Failures. Trade-Spaces in Adding Autonomous Capabilities.

UNIT-II

Software Organization of Autonomy: Overview, The Three Types of Software Architectures. Canonical AI Robotics Operational Architecture. Other Operational Architectures. Five Subsystems in Systems Architectures. Three Systems Architecture Paradigms. Execution Approval and Task Execution.

Perception and Behaviors: Overview. Action-Perception Cycle. Gibson: Ecological Approach. Two Functions of Perception. Cockroach Hiding.

UNIT-III

Sensors and Sensing: Overview. Sensor and Sensing Model. Odometry, Inertial Navigation System (INS) and Global Positioning System (GPS). Proximity Sensors, Computer Vision, Choosing Sensors and Sensing.

UNIT-IV

Navigation: Overview, The Four Questions of Navigation. Spatial Memory. Types of Path Planning. Landmarks and Gateways, Relational Methods, Associative Methods. Case Study of Topological Navigation with a Hybrid Architecture.

Learning: Overview. Learning. Types of Learning by Example. Common Supervised Learning Algorithms. Common Unsupervised Learning Algorithms, Reinforcement Learning, Evolutionary Robotics and Genetic Algorithms. Learning and Architecture.

UNIT-V

Interactive Functionality: MultiRobot Systems (MRS): Overview, Four Opportunities and Seven Challenges, Multirobot Systems and AI. Designing MRS for Tasks. Coordination Dimension of MRS Design. Five Most Common Occurrences of MRS. Operational Architectures for MRS. Task Allocation.

Text book:

1. *Introduction to AI Robotics, Robin R. Murphy, Second edition. Cambridge, MA: The MIT Press, 2019.*

Reference books:

1. *Fundamentals of Robotics Paperback – 1 January 2017 by D K Pratihar.*
2. *Robotics, Vision, and Control: Fundamental Algorithms in MATLAB by Peter Corke.*

e-Resources:

1. *Introduction to robotics, IIT Madras, Dr. Krishna Vasudevan, Dr. T Asokan, Dr. Balaraman Ravindran - https://nptel.ac.in/courses/107106090*

Course code	Course Title						Core/ Elective
U22PE634CB	Crypto Currencies						Elective
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
Cryptography	3	0	0	0	30	70	3

Course Objectives:

1. To introduce the concepts of digital money and crypto wallets
2. To explore on bitcoin and its transaction workflows
3. To infer on other alternate crypto currencies in current digital market
4. To learn managing electronic wallets
5. To comprehend the importance of cryptographic keys and addresses

Course Outcomes:

At the end of the course Students will be able to

1. Understand the core functionality and utility of Crypto currency technologies.
2. Familiarize with working of different keys, crypto wallets and addresses.
3. Explain the transactions flows in bitcoin networks.
4. Explore the concepts on peer-to-peer architecture, bitcoin network nodes, bloom filters.
5. Analyze and compare various crypto currencies and also bitcoin security issues.

UNIT-I

Introduction: Forms of Money: Physical and Digital money, How to define money, a brief history of money-dispelling the myths, Digital money:How interbank payments are made, E-money wallets.

Bitcoin: Definition, History, Bitcoin uses, users and their stories, Bitcoin overview, Bitcoin Transactions, Constructing a transaction, Bitcoin mining, Mining transactions in blocks, spending the transactions.

UNIT-II

Keys, Addresses and Wallets: Introduction**:** Public Key Cryptography and Cryptocurrency, Private and Public Keys, Elliptic Curve Cryptography Explained, Generating a Public Key, Bitcoin Addresses, Wallets:Non deterministic (Random) Wallets, Deterministic (Seeded) Wallets, Mnemonic Code Words, Hierarchical Deterministic Wallets.

UNIT-III

Bitcoin Transactions: Transaction lifecycle, Transaction structure, Transaction outputs and inputs, Standard transactions: Pay-to-Public-Key-Hash (P2PKH), Pay-to-Public-Key, Multi-Signature, Data Output (OP_RETURN),Pay-to-Script-Hash (P2SH)

UNIT-IV

Bitcoin network: Peer-to-Peer architecture, Nodes types and roles, The extended bitcoin network, network discovery, full nodes, Simplified Payment Verification (SPV) Nodes, Bloom filters. Transaction pools, alert messages.

UNIT-V

Alternative Chains, Currencies and Applications: A Taxonomy of Alternative Currencies and Chains, Alt Coins, Non Currency Alt Chains. Bitcoin Security: Security Principles, User Security Best Practices.

Textbooks:

1. *"Mastering Bitcoin - Unlocking Digital Cryptocurrencies" by Andreas M. Antonopoulos, 2015, O'REILLY.*
2. *"The Basics of Bitcoins and Blockchains: An Introduction to Cryptocurrencies and the Technology that Powers Them " - 2018, by Antony Lewis, Mango publishing.*

References:

1. *"Bitcoin And Cryptocurrency Technologies - A Comprehensive Introduction" by Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, And Steven Goldfeder , 2016, Princeton University Press.*

e-Resources:

1. *Diploma in Cryptocurrency, Alison - https://alison.com/course/diploma-in-cryptocurrency*

Course Code	Course Title						Core/ Elective
U22PE635CB	Natural Language Processing						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Machine Learning	3	-	-	-	30	70	3

Course Objectives:

The main objectives of this course are to

1. Learn NLP tasks in syntax, semantics, pragmatics, and understand machine learning, probability, and N-gram models.
2. Understand morphology, finite state transducers, POS tagging, including HMMs and Maximum Entropy Models (MEMs).
3. Overview grammar formalisms, treebanks, CFG parsing, probabilistic CFGs (PCFGs), and lexicalized PCFGs.
4. Learn meaning representation, lexical semantics, word sense disambiguation, compositional semantics, SRL, and semantic parsing.
5. Study discourse segmentation, coherence, reference, anaphora resolution, lexical resources, and Named Entity Recognition (NER).

Course Outcomes:

After Successful completion of the Course, the student will be able to:

1. Understand NLP tasks in syntax, semantics, and pragmatics, along with the application of machine learning in various contexts.
2. Apply morphological analysis and POS tagging techniques using rule-based, statistical, and probabilistic models.
3. Implement syntax parsing using CFGs and statistical methods for efficient natural language understanding.
4. Analyze meaning representation, word sense disambiguation, and semantic role labeling for deeper comprehension of language.
5. Apply discourse analysis techniques and utilize lexical resources for tasks like NER, relation extraction, and machine translation.

UNIT-I

Introduction to Natural Language Processing (NLP) tasks in syntax, semantics, and pragmatics. Overview of applications and the role of machine learning. Basics of probability and information theory. N-gram language models and evaluation methods.

UNIT-II

Morphology and Part of Speech (POS) Tagging: Linguistic essentials, morphology, and finite state transducers. POS tagging methods including rule-based, Markov models, Hidden Markov Models (HMMs), and Maximum Entropy Models (MEMs).

UNIT-III

Syntax Parsing: Overview of grammar formalisms and treebanks. Parsing with Context Free Grammars (CFGs) and statistical parsing techniques such as probabilistic CFGs (PCFGs) and lexicalized PCFGs.

UNIT-IV

Semantic Analysis: Representation of meaning, lexical semantics, word sense disambiguation, and compositional semantics. Introduction to Semantic Role Labeling (SRL) and Semantic Parsing.

UNIT-V

Discourse Analysis and Lexical Resources: Discourse segmentation, coherence, and reference phenomena. Anaphora resolution methods and resources including Porter Stemmer, Lemmatizer, Penn Treebank, WordNet, PropBank, FrameNet, and corpora like the Brown Corpus and British National Corpus (BNC). Introduction to Named Entity Recognition (NER), Relation Extraction, and Machine Translation (MT) applications in NLP.

Text Books:

1. *Daniel Jurafsky and James H. Martin Speech and Language Processing (2nd Edition), Prentice Hall; 2 edition,2008*
2. *Foundations of Statistical Natural Language Processing by Christopher D.Manning and HinrichSchuetze, MIT Press,1999*
3. *Steven Bird, Ewan Klein and Edward Loper Natural Language Processing with Python, O'Reilly Media; 1 edition,2009 Roland R. Hausser, Foundations of Computational Linguistics: Human-Computer Communication in Natural Language, Paperback, MIT Press,2011*

Reference Books*:*

1. *Pierre M. Nugues, An Introduction to Language Processing with Perl and Prolog: An Outline of Theories, Implementation, and Application with Special Consideration of English, French, and German (Cognitive Technologies) Softcover reprint,2010*
2. *James Allen, Natural Language Understanding, Addison Wesley; 2nd Edition 1994, NLTK – Natural Language ToolKit-http://www.nltk.org/.*

e-Resources:

1. *Natural Language Processing, IIT Kharagpur, Prof. Pawan Goyal - https://nptel.ac.in/courses/106105158*

OPEN ELECTIVE-I

Course Code	Course Title						Core/Elective
U21OE611AE	Automobile Engineering						Open Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	3	-	30	70	3

Course Objectives:

It is intended to make the students to

1. Understand the Working of Fuel, Ignition, and cooling Systems
2. Understand the Working of Lubrication and Electrical Systems.
3. Understand the Working of transmission, Suspension, Steering and Braking Systems.
4. To provide broad introduction to Alternative Energy Sources, Euro norms and Bharat Norms.

Course Outcomes:

After completing this course, the student will be able to

1. Generalize the different types of automobiles and engine components.
2. Differentiate the Fuel system and electrical system.
3. Describe and differentiate the Transmission Systems.
4. To identify different components and working of Steering, Brakes and Suspension systems.
5. Adapt techniques, skills and modern engineering tools necessary to control the pollution.

UNIT-I

Vehicle Structure and Engines: Types of Automobiles, Vehicle Construction, Chassis, Frame and Body , Components of Engine , Cooling and Lubrication systems in Engine, Turbo Chargers, Engine Emission Control by 3 Way Catalytic Controller, Electronic Engine Management System.

UNIT-II

Engine Auxiliary Systems: Carburettor working principle, Electronic fuel injection system, single-point and Multi-Point Injection Systems, Electrical systems, Battery, generator, Starting Motor and Lighting and Ignition.

UNIT-III

Transmission Systems-Clutch: Types and Construction, Gear Boxes-Manual and Automatic, Over Drives, Transfer Box Fluid flywheel Torque convertors, Propeller shaft – Slip Joint – Universal Joints, Differential and Rear Axle, Hotchkiss Drive and Torque Tube Drive.

UNIT-IV

Steering, Brakes and Suspension: Wheels and Tires – Wheel Alignment Parameters, Steering

Geometry and Types of steering gear box, Power Steering, Types of Front Axle – Suspension systems. Braking Systems, Types and Construction, Antilock Braking System.

UNIT-V

Alternative Energy Sources:Use of Natural Gas, LPG, Biodiesel, Gasohol and Hydrogen in Automobiles, Electric and Hybrid Vehicles, Fuel Cells. Euro and Bharat Norms. Recent trends.

Suggested Readings:

1. *Crouse & Anglin, 'Automotive Mechanics' Tata McGraw Hill, PublishingCo., Ltd., New Delhi, Tenth edition - 2004.*
2. *Kirpal Singh, "Automobile Engineering", Vol I & II Standard Publishers,Delhi.*
3. *Joseph Heitner, 'Automotive Mechanics', Affiliated East West Pvt., Ltd.,*
4. *C.P. Nakra, "Basic Automobile Engineering", Dhanpat Rai PublishingCo.(P) Ltd., New Delhi, 2003.*

Course Code	Course Title						Core/ Elective
U21OE611CE	Disaster Mitigation						Open Elective
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
-	3	-	-	-	30	70	3

Course Objectives: The objective of this course is to impart knowledge on

1. Basic principles of disaster management.
2. Various types of disasters
3. Disaster management cycle and framework
4. Disaster management systems in India.
5. Applications of the latest technologies in disaster management.

Course Outcomes: After completing this course, the students will be able to

1. Define and explain the terms, concepts related to disaster and categories of disasters.
2. Describe the various Hydro – Metrological based disasters and their specific characteristics.
3. Describe the various Geographical based disasters and their specific characteristics
4. Describe the various Human induced and Human Made hazards and Biological based disasters and their specific characteristics.
5. List and explain the various technological applications to aid disaster management.

UNIT-I

Introduction: Understanding the Concepts and definitions of Disaster, Hazard, vulnerability and risk and Capacity, Types of disasters, Disaster and Development and disaster management.

UNIT-II

Natural Disasters - Hydro- Meteorological based disasters: Floods, drought, cold and heat waves and desertification zones - Causes, Types, effects and Mitigation measures.

UNIT-III

Natural Disasters Geographical based disasters: Earthquake, Tsunamis, Landslides mining and avalanches - Causes, Types, effects and Mitigation measures.

UNIT-IV

Human induced and Human Made hazards: Chemical industrial hazards, Technological hazards, traffic accidents. - Causes, Types, effects and Mitigation measures.
Biological Disasters: Epidemics, pest attacks, forest fire- Causes, Types, effects and Mitigation measures.

UNIT-V

Role of Remote Sensing and Geographical Information Systems (GIS) in Disaster Management: Introduction to remote sensing and GIS, its applications in disaster management. Disaster management cycle, Disaster

management act, Disaster management in India. Progress of disaster management in world.

Text Books:

1. *Pradeep Sahni, "Disaster Risk Reduction in South Asia", Prentice Hall, 2004.*
2. *Singh B.K., "Handbook of Disaster Management: Techniques & Guidelines", Rajat Publication, 2008.*
3. *Ghosh G.K., "Disaster Management", APH Publishing Corporation, 2006.*

Reference Books:

1. *Rajib, S and Krishna Murthy, R.R., "Disaster management Global Challenges and Local Solutions", Universities Press, Hyderabad, 2012*
2. *Navele, P & Raja, C.K., "Earth and Atmospheric Disasters Management, Natural and Manmade", B.S. Publications, Hyderabad, 2009.*
3. *Battacharya, T., "Disaster Science and Management", Tata McGraw Hill Company, NewDelhi, 2012.*

Course Code	Course Title						Core/ Elective
U21OE611CS	Fundamentals of Data structures						Open Elective
Prerequisites	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
---	3	-	-	3	30	70	3

Course Objectives

1. To learn how to write algorithms and analyze.
2. To learn the linear and non-linear data structures.
3. To explore the applications of linear and non-linear data structures.
4. To learn to represent data using graph data structure.
5. To learn the basic sorting and searching algorithms.

Course Outcomes

Upon completion of the course, the students will be able to:

1. Implement linear and non-linear data structure operations using a computer language
2. Suggest appropriate linear / non-linear data structure for any given data set.
3. Apply hashing concepts for a given problem
4. Modify or suggest new data structure for an application
5. Appropriately choose the sorting and searching algorithm for an application.

UNIT-I

Introduction: Algorithm Specifications, Recursive algorithms, Performance Analysis (Time and space analysis of algorithms - Average, best and worst case analysis), Data structure- Definition, classification.

UNIT-II

Linear Data structures

Array: Representation of arrays, Applications of arrays-Polynomial representation Stack: Introduction to Stack, Definition, Stack Operations, Applications of stacks Queue: Introduction to Queue, Definition, Queue Operations, Applications of queues.

UNIT-III

Linear Data structures

Linked Lists : Introduction, Representation and Operations of Linked Lists, Singly Linked List, Application: stack,queue-Operations,Polynomial representation ,Doubly Linked List, Circular Linked List.

UNIT-IV

Non-Linear Data structures

Trees: Tree Terminology, Binary Tree, Strictly Binary Tree, Complete Binary Tree,Tree traversals,

Binary Search Tree and operations.
Set representations – Union and Find operations Graphs: Representations, Traversals.

UNIT-V

Linear Search, Binary Search., Bubble Sort, Insertion sort, Merge sort, Quick sort, Hashing– Overflow handling.

***Text Books*:**

1. *Fundamentals of Data Structures in C-Ellis Horowitz, Sartaj Sahni, Susan Anderson- Freed Second Edition, University Press, 2008.*
2. *Data Structures Using C and C++ - Yedidyah Langsam, Moshe J. Augenstein, Aaron M.Tanenbaum-2ndEdition,PHI Publications*
3. *Fundamentals of Computer Algorithms- Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran-2ndedition,University Press ,2008*

***References*:**

1. *Data Structures Through C- Yashwant Kanetkar, 2nd edition, BPB Publications Data Structures and Algorithms in C++ - Adam Drozdek.*

Course Code	Course Title						Core / Elective
U21OE611EC	**Principles of Electronic Communication**						**Open Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	**Credits**
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

1. Provide an introduction to fundamental concepts in the understanding of communications systems.
2. Provide an introduction to fundamental concepts in the understanding of Analog and Digital modulation techniques.
3. Provide an introduction to satellite communications with orbitals and different communication satellites.
4. Provide an introduction to the optical communications in understanding different sources, detectors and losses.
5. Provide an introduction to the evolution of GPS in understanding orbital mechanics and different augmentation systems.

Course Outcomes

1. Understand the working of basic communication systems
2. Understand the working of different analog and digital communication systems.
3. Understand the evolution of satellite communication technologies from orbital mechanics to communication satellites.
4. Understand the evolution of optical communication technologies along with optical laws and different losses.
5. Understand the evolution of GPS communication system and different augmentation systems.

UNIT-I

Introduction to communication systems: Electromagnetic Frequency Spectrum, Signal and its representation, Elements of Electronic Communications System, Types of Communication Channels.
Communication Parameters: Transmitted power, Channel bandwidth and Noise.
Signal Radiation and Propagation: Principle of electromagnetic radiation, Qualitative treatment of parabolic reflector, Micro strip antennas.

UNIT-II

Analog and Digital Communications: Need for Modulation, Amplitude modulation and demodulation, FM modulation and demodulation, Analog to Digital Conversion, Digital modulation schemes – ASK, FSK, PSK, Digital demodulation.

UNIT-III

Satellite Communication: Introduction to Satellite Communication, geosynchronous and geo-stationary satellites, Kepler's laws, LEO, MEO, GEO, Link-power budget equation, Indian scenario in

communication satellites.

UNIT-IV

Optical Communications: Optical Principles, block diagram of Optical Communication System, advantages and disadvantages, Optical sources and detectors, Fiber–Optic Cables, bending losses and propagation losses.

UNIT-V

GPS Fundamentals: GPS Constellation, Principles of operation, GPS Orbits, Orbital mechanics and satellite position determination.

Qualitative treatment of Wide Area Augmentation System (WAAS) architecture and Local Area Augmentation System (LAAS), GPS Aided GEO Augmented Navigation (GAGAN).

Textbooks:

1. *Louis E. Frenzel, "Principles of Electronic Communication Systems", 3e, McGraw Hill,2008.*
2. *Kennady, Davis, "Electronic Communications systems", 4e, McGraw Hill,1999.*

Reference:

1. *Timothy Pratt and Charles Bostian, "Satellite Communications", John Wiley, 1986.*
2. *Basudeb Bhatta," Global Navigation Satellite Systems: Insights into GPS, GLONASS, Galileo, Compass", B.S. Publications.*

Course Code	Course Title						Core/ Elective
U21OE612EC	Electronic Instrumentation						Open Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
----	3	-	-	-	30	70	3

Course Objectives:

1. Understand the different standards of measurements.
2. Study different types of transducers.
3. List various types of measurements and thermometers.
4. Learn the design of digital volt meters.
5. Study various types of bio-medical instruments.

Course Outcomes:

1. Describe characteristic of an instrument and state different Standards of measurements.
2. Identify and explain different types of Transducers.
3. Draw and Interpret types of transducers.
4. Design and analyse the digital voltmeters and Prioritize the instruments.
5. Identify and classify types of Biomedical instruments.

UNIT-I

Electronic Measurement fundamentalsAccuracy, Precision, Resolution and Sensitivity. Errors and their types. Standards of measurement, classification of standards, IEEE standards.

UNIT-II

Transducers: Classification, factors for selection of a transducer, transducers for measurement of velocity, acceleration. Passive electrical transducers- Strain gauges and strain measurement, Linear Variable Differential Transformer (LVDT). Active electrical transducers: Piezo-electric, photo conductive, photo voltaic and photo emissive transducers.

UNIT-III

Electronic Instruments for Measuring Basic Parameters: Voltmeters, Ammeters, Ohmmeters, Digital Meters.

Digital multimeters: Block diagram and specifications and different types of DVMs like Ramp type, Integrating type and Successive approximation type. Advantages of Digital volt Meters (DVM) over other Voltmeters.

UNIT-IV

Oscilloscopes: Cathode Ray Tube, Vertical and Horizontal Deflection Systems, Specification of an Oscilloscope. Measurement of Amplitude, Frequency and Phase measurement. Special Oscilloscopes –

Storage Oscilloscope, Sampling Oscilloscope.

UNIT-V

Biomedical Instrumentation:

Human physiological systems and related concepts. Qualitative treatment of Electrocardiography (ECG), Electroencephalography (EEG), Electromyography (EMG), Comparison of ECG, EEG and EMG. Introduction to X- ray machines and Computed Tomography (CT) scanners.

Text Books:

1. *H.S. Kalsi, "Electronic Instrumentation", TMH.*
2. *Khandpur R.S., "Handbook of Bio-Medical Instrumentation", TMH.*

Reference Books :

1. *David A. Bell, "Electronic Instrumentation & Measurements", PHI.*
2. *Albert D. Helfric, and William D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", PHI.*

CourseCode	CourseTitle						Core/ Elective
U21OE611EE	**Electrical Energy Conservation and Safety**						**Open Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

1. To understand the concepts of basic energy and various forms of energy.
2. To understand the energy management and need of energy audit.
3. To understand the energy efficiency technologies.

Course Outcomes

1. At the end of the course students will be able to
2. Demonstrate the current energy scenario and importance of energy conservation.
3. Make use of the concepts of energy management.
4. Analyze the methods of improving energy efficiency in different electrical systems.
5. Choose different energy efficient devices.
6. Apply electrical safety.

UNIT-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 scenario, energy pricing, energy sector reforms, energy and environment,energysecurity,energyconservationanditsimportance,restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. EnergyConservationAct-2001anditsfeatures.

UNIT-II

Basics of Energy and its various forms: Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity& heat transfer, units and conversion.

UNIT-III

Energy Efficiency in Electrical Systems: Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.

UNIT-IV

Energy Efficient Technologies in Electrical Systems: Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

UNIT-V

Electrical Safety: Physiological effects of Electricity, Important Susceptibility parameters, Distribution of Electric Power, Macro shock hazards, Micro Shock hazards, Electrical - Safety codes and Standards, Basic Approaches to protection against shock , Protection: Power distribution, Protection: Equipment Design, Electrical Safety Analyzers, Testing the Electrical System. Test of Electric Appliances.

Text Books:

1. *Guide books for National Certification Examination for Energy Manager /Energy Auditors Book-1, General Aspects (available online).*
2. *Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online).*
3. *S.C.Tripathy, Utilization of Electrical Energy and Conservation,McGrawHill,1991.*

Reference Books:

1. *Success stories of Energy Conservation by BEE 8,9 New Delhi(www.bee-india.org).*

Course Code	Course Title						Core/ Elective
U21OE611IT	Database Systems						Open Elective
Pre requisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives :

The student will be able

1. To understand the basic concept of DBMS
2. To understand basics of SQL
3. To learn to design develop and query the database
4. To learn data base administration and transaction processing
5. To understand security aspects related to database

Course Outcomes :

After completing this course the student will be able to:

1. Understand the concepts related to database
2. Understand basics of structured query language
3. Design, Develop and Query the database
4. Learn data base administration and transaction processing
5. Understand security aspects related to database

UNIT-I

Data and Data Management: Role of Data and Databases
Database and Database Management System: Key Data base concepts-Basic Data base Models-Database Components.
Data Modeling: Database Design-Relational Database Models-Relationships-Comparing Data Models

UNIT-II

SQL language: SQL features-command basics-SELECT Fundamentals- Operators and Functions-DDL Commands – DML Commands.
Data Access and Manipulation: SELECT statement Advanced Syntax- Joins and Sub Queries.
SQL Procedures: SQL procedures and Functions-Triggers

UNIT-III

Designing a Database: Designing Relational Tables-Comparing Relational Designs – Normalizing Data.
Implementing a Database: Physical Design and Implementation – Adjusting Design to the RealWorld-Implementing Data base Objects.

UNIT-IV

Improving Data Access: Performance Rollbacks-Using Indexes and Views-Using Programmable objects.
Database Administration: Need for Administration-Administration Responsibilities – Management Task.

UNIT-V

Transactions and Locking: Transaction Basics – Managing Concurrency control-SQL server transaction management.

Database Access and Security: Database Connections-Managing Access Control – Protecting data.

Text Books:

1. *Mark L. Gillenson, PaulrajPonniah., ―Introduction to Database Management‖, John Wiley&SonsLtd,2008.*
2. *LeeChao, "DatabaseDevelopmentandManagement",AuerbachPublications,2006.*
3. *RobCoronel,"Database Systems:Design, Implementation &Management" Thomson CourseTechnology, 2000.*

Course Code	Course Title						Core / Elective
U21OE611ME	Operations Research & Techniques						Open Elective
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	P	D			
Engineering Mathematics	3	-	-	-	30	70	3

Course Objectives

The objective of this course are to

1. Use variables for formulating complex mathematical models in management science, industrial engineering and transportation models.
2. Use the basic methodology for the solution of linear programming problems.
3. Understand the mathematical tools that are needed to solve optimization problems like Transportation models and Assignment models.
4. Understand the replacement models with change in money value considering with time and without time.
5. Model a system as a queuing model and compute important performance measures.

Course Outcomes

Upon completion of course, students will be able to

1. Paraphrase the real time problem and develop a graphical or analytical linear programming model for maximization or minimization condition.
2. Categorize complex linear programming problem and apply duality concept for developing optimum Solution model.
3. Construct cost minimization model for transportation and resource allocation situations.
4. Recommend optimum criteria for maintenance and conflict situations by implementing suitable models
5. Analyse waiting line, resource scheduling situations and develop optimum solution.

UNIT-I

Introduction: Definition, Scope, applications of Operations Research& Techniques

Linear Programming: Introduction, formulation of linear programming problems, graphical method of solving LP problem, simplex method, maximization and minimization.

UNIT-II

Inventory Control: Importance of inventory control, types of inventory models Inventory costs deterministic inventory models Basic EOQ models, production model without shortages, Purchase model with instantaneous replenishment and with shortages production model with shortages.

UNIT-III

Assignment Problems: Hungarian method of Assignment problem, travelling salesman problem.

Sequencing Models: Introduction, General assumptions, processing ‘n’ jobs through 2 machines, processing ‘n’ jobs through 3 machines.

UNIT-IV

Game Theory: Introduction, Two-person zero sum games, Maximin – Minimax principle, Principle of Dominance, Solution for mixed strategy problems.

Replacement Models: Introduction, replacement of items that deteriorate ignoring change in money value, replacement of items that deteriorate considering change in money value with time

UNIT-V

Project Management: Project management: Network fundamentals, difference between PERT/CPM Scheduling the activities, Fulkerson's rule, Earliest and latest times, Determination of ES and EF in the forward path, LS and LF in backward path, Determination of critical path. Free float, independent float, Total float, Program Evaluation and Review Technique.

Text Books:

1. *Operations Research – An Introduction, Hamdy, A. Taha, 6th Edition, Prentice Hall of India Pvt. Ltd., 1997.*
2. *Operations Research, S.D. Sharma, Kedarnath, Ramnath & Co., Meerut, 2009.*
3. *Operations Research, S. Kalavathy, 4th Edition, Vikas Publishing House Pvt. Ltd., 2018.*

Reference Books:

1. *Operations Research, P. Sankara Iyer, Tata McGraw-Hill Publishing Company Ltd., 2009.*
2. *Operations Research, V.K. Kapoor, S. Chand Publishers, New Delhi, 2004.*
3. *Operations Research, R. Panneer Selvam, 2nd Edition, Prentice Hall of India (P) Ltd., New Delhi, 2008.*

Course Code	Course Title						Core / Elective
U21OE612ME	Industrial Robotics						Open Elective
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	P	D			
Applied Physics, Applied Mechanics, Engineering Mathematics	3	-	-	-	30	70	3

Course Objectives

To create awareness on types of robots and their working functions through various physical systems and related mechanics.

Course Outcomes

Upon completion of course, students will be able to

1. Demonstrate knowledge of the relationship between mechanical structures of industrial robots and their operational workspace characteristics and have an understanding of the functionality and limitations of robot actuators and sensors.
2. Demonstrate an ability to apply special transformation to obtain forward / inverse kinematics equation of robot manipulators using analytical / numerical / simulation tools.
3. Apply knowledge and choose the best & economically suitable sensors / end effectors required for specific applications.
4. Analyse the importance of robot vision and apply the learnt techniques to get the required information from input images.
5. Design an industrial robot for a given purpose economically.

UNIT-I

Introduction to Robotics

Brief history, types of robots, overview of robot subsystems, resolution, repeatability and accuracy, degrees of freedom of robots, robot configurations and concept of workspace,

End effectors, Grippers: Mechanical grippers, pneumatic and hydraulic grippers, magnetic grippers, vacuum grippers, RCC grippers, two fingered and three fingered grippers, internal grippers and external grippers, selection and design considerations.

UNIT-II

Requirements of a Sensor

Principles and Applications of the following types of sensors – Position of sensors (Piezo electric screw, LVDT, Resolvers, optical encoders, Pneumatic position sensors), Range sensors (Triangulation principle, Structured, Lighting approach, Time of flight range finders, Laser range meters), Proximity sensors (Binary sensors, Analog sensors), Wrist sensors, Compliance sensors, Slip sensors.

UNIT-III

Kinematic Analysis of Robots

Rotation matrix. Homogeneous transformation matrix, Denavit&Hartenberg representation, Euler and RPY angles representation, Representation of absolute position and orientation in terms of joint parameters, direct kinematics of manipulators, Inverse kinematics of Robot arm for position and orientation. Redundancy in Robots, Static force analysis.

UNIT-IV

Introduction to Techniques used in Robot Vision

Image acquisition, illumination techniques, imaging geometry, basic relationship pixels, preprocessing, segmentation & description of 3 dimensional structures, their recognition and interpretation. Types of Camera, frame grabbing, sensing and digitalizing image data, Signal conversion, image storage, lighting, techniques, image processing and analysis, data reduction, segmentation, feature extraction, object recognition and various algorithms, applications, inspection, identification, visual and navigation.

UNIT-V

Robot Programming Languages

Characteristics of robot level languages, task level languages. Teach pendant programming, lead through programming, robot programming languages, VAL programming, Motion commands, sensor commands. End effecter commands, simple programs. RGV&AGV, implementation of robots in industries, various steps, safety considerations for robot operations. Economic analysis of robots, pay back method, EUAC method and Rate of return method.

Text Books:

1. *Industrial Robotics, Groover M P, McGraw Hill Publications, 1999.*
2. *Robot Dynamics & Control, Spong and Vidyasagar, John Wiley and Sons, Ed., 1990*
3. *Industrial Robotics, Mittal and Nagrath, Tata McGraw Hill Publications, 2004.*

Reference Books:

1. *Robotics Control-sensing Vision and Intelligence, Fu K.S., Gonzalez R.C., Lee C.S.G., McGraw Hill, Int. Ed., 1987.*

Course Code	Course Title						Core / Elective
U21OE611EG	**Soft Skills and Interpersonal Skills**						**Open Elective**
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	P	D			
	3	-	-	-	30	70	3

Course Objectives:

1. To train the students in effective listening skills required for professional communication
2. To enable the students to develop the required speaking skills for professional Communication
3. To equip the students with appropriate reading strategies required professionally
4. To develop professional writing skills among students
5. To equip the students with the right attitude and coping techniques required professionally

Course Outcomes:

By the end of the course students will be able to:

1. Listen to a variety of speakers and texts and will be able to comprehend and perform required tasks
2. Speak and respond appropriately as per the task requirement
3. Read a variety of texts, comprehend, summarize them and perform the required tasks
4. Write and publish a variety of documents such as letters, memos, emails, blogs, reports, cover letters and resume
5. Demonstrate the right attitude and skills to cope with organizing and communicating professionally.

UNIT-I

Introduction and Skills of Listening

Definition, Nature and scope of Soft Skills, Importance of soft skills, Need for soft skills in academic and workplaces, Aptitude for Standardized tests

a. Listening Skills: Types of Listening, Active listening, Non-Verbal symbols of active listening, Importance of Listening in academic and professional communication
b. Listening Skills through varied activities: Ted talks, Professional Lectures on YouTube, TV, Radio, Classroom lectures – Note taking, IELTS/TOEFL based activities.

UNIT-II

Skills of Speaking

Presentation Skills Communication within Teams – Johari Window, Tuck's Model, Participating in GDs – Negotiation Skills, Interview Skills.

UNIT-III

Skills of Reading for Communication

Effective Reading -Sub Skills of Reading- skimming, scanning, Inference

Vocabulary Development- Synonyms & Antonyms- Idiomatic Expressions – One Word Substitute- Words often Confused Reading different genres of texts – Ranging from Newspapers to Philosophical treaties

-Short stories & Novels, Auto Biographies/Biographies, Plays (conversational skills),

Personality Development Skills
(b) Graphic Organizers and summarizing skills

UNIT-IV
Skills of Effective Writing
Writing Types –Free Writing, Expository, Descriptive, Narrative, Persuasive
Writing for different purposes – publications, letters (formal -informal) , emails, blogs, cover letters & resume building, Punctuation
Barriers of Writing skills -Noise, lack of effective tools, training for writing, scope of motivation, writer's block

UNIT-V
Specific Soft Skills
Time Management Emotional intelligence Spiritual Quotient (ethics)
Motivation and goal setting, Stress Management
Creative and Critical Thinking, Decision Making, Leadership Skills Learning styles and strategies

Suggested Reading:

1. *Andrea J. Rutherford. Basic Communication Skills for Technology. Pearson Education, Inc.New Delhi, 2001.*
2. *Anne Dannellon. Team Talk: The Power of Language in Team Dynamics. Harvard Business School Press, Boston, Massachusetts, 1996.*
3. *Antony Jay and Ros Jay. Effective Presentation: How to be a Top Class Presenter. Universities Press (India) Limited, 1999.*
4. *Ashraf.M. Rizvi, Effective Technical Communication. Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2005*
5. *Daniel Goldman. Emotional Intelligence. New York, Bantam Books, 1995.*
6. *Friedrike Klippel. Keep Talking. Cambridge University Press, London, 1984.*
7. *K.K. Sinha Business CommunicationGalgotia Publishing Company GPC, New Delhi, 1999.*
8. *Lewis.HedwigBody Language: A Guide for Professionals.Response Books (a division of Sage Publications India, Pvt. Ltd.,) New Delhi., 1998.*
9. *Hari Mohan Prasad and Rajnish Mohan. How to prepare for Group Discussion and Interview. 2nd Edition, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2005*
10. *Mitra, Barun. Personality Development and Soft Skills*
11. *Goodheart and Willcox. Soft Skills at Workplace.*

Course Code	Course Title						Core / Elective
U22PCN81AL	Distributed Systems and Cloud Computing Lab						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
CN, OS	-	-	-	2	25	50	1

Course Objectives

1. Understanding Remote Communication and virtualization concepts
2. To understand multithreading concepts using sockets
3. To understand transaction management protocols
4. Understanding Name Resolution techniques.
5. To learn about integrating different Databases with cloud
6. To use Map, reduce model for distributed processing
7. To understand how to deploy web application using node JS

Course Outcomes

After completing this course, the student will be able to

1. To Implement RMI and instance creation accessing using virtualization.
2. To develop programs that communicate data between two hosts and FTP
3. To Implement 2PC and DNS
4. To Implement Map, reduce model for distributed processing
5. To integrate different Databases with cloud and Application development.

List of Experiments to be performed:

Create an instance and connect an access using Virtualization

1. Implement RMI (remote Method Invocation)
2. Implementation of Chat Server
3. Implementation FTP Client and Server
4. Implement 2PC(Two Phase Commit Protocol)
5. Implementation of DNS Domain Name Server
6. Integrating MySQL database services from Cloud
7. Implementing CASANDRA (CRUD operatrions)
8. Implementing data base using Google Big Table
9. Implement a word count application which counts the number of occurrences of each word a large collection of documents Using Map Reduce model.
10. Deploying Web Page on cloud using Node JS

***Suggested Tools**:*

1. *Apache Tomcat, MySQL community server, NetBeans IDE, Apache Cassandra, NodeJS, Glitch, Google BigTable / MongoDB for NoSQL, Hadoop*

Course Code	Course Title						Core / Elective
U21PC682CS	Artificial Intelligence and Machine Learning Lab						Core
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
Engg. Math., Data structures	-	-	-	4	25	50	2

Course Objectives:

1. To apply programming skills to formulate the solutions for computational problems.
2. To study implementation first order predicate calculus using Prolog
3. To understand python library scikit-learn for building supervised machine learning models.
4. To understand python library scikit-learn for implementing clustering algorithms.
5. To enrich knowledge to select and apply relevant AI tools for the given problem.

Course Outcomes:

On completion of this course, the student will be able to-

1. Design and develop solutions for informed and uninformed search problems in AI.
2. Demonstrate reasoning in first order logic using Prolog.
3. Select and apply python libraries to synthesize information and develop supervised learning models.
4. Evaluate and compare classifier models using relevant measures.
5. Apply unsupervised learning algorithms and interpret the results

LIST OF EXPERIMENTS

1. Write a program to implement Uninformed Search Techniques
    a. BFS
    b. DFS
2. Write a program to implement Informed Search Techniques
    a. Greedy Best First Search
    b. A* algorithm
3. Study of Prolog, its facts, and rules
    a. Write simple facts for the statements and query them.
    b. Write a program for family tree.
4. Regression
    a. Write a program to build a Linear regression model and estimate output using the model.
5. Classification: Write a program to demonstrate the following classifiers. Use an appropriate dataset for building the model and classify a new instance.
    a. Logistic Regression
    b. Naïve Bayes
    c. Decision Tree
    d. kNN

    e. SVM
    f. Multi-Layer Perceptron (MLP)
6. Evaluate various classification algorithms performance on a dataset using measures such as True positive rate, False positive rate, F-score, Accuracy etc.
7. Clustering: Write a program to demonstrate the following algorithms
    a. K means
    b. Hierarchical (Agglomerative)
    c. Expectation Maximization (Gaussian Mixture)

***Suggested Tools**: Anaconda, TensorFlow, Numpy, Jupyter Notebook, Google CoLab*

Course Code	Course Title						Core/ Elective
U22PC683AL	DevOps Lab						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Software Engineering	-	-	-	4	25	50	2

Course Objectives: The main objectives of this course are to teach students:

1. How to create simple web apps and manage code with Git and GitHub.
2. To install, set up, and use Jenkins for automating software development.
3. Hands-on experience with Docker to containerize and manage applications.
4. To integrate Docker with Kubernetes for automated deployment and scaling of applications.
5. To write and run automated tests using Selenium to ensure software quality.

Course Outcomes: After completing this course, the student will be able to:

1. Apply Git and GitHub commands to manage and collaborate on source code.
2. Analyze and set up Jenkins to demonstrate continuous integration and development processes.
3. Deploy a simple application using Docker and integrate it with Kubernetes to automate deployment and scaling.
4. Write JavaScript programs and develop test cases for containerized applications using Selenium for automated testing.
5. Integrate GitHub, Jenkins, Docker, Kubernetes, and Selenium to develop a complete, automated DevOps pipeline.

List of Programs:

1. Write code for a simple user registration form for an event.
2. Explore Git and GitHub commands.
3. Practice Source code management on GitHub. Experiment with source code written in program 1.
4. Jenkins installation and setup, explore the environment.
5. Demonstrate continuous integration and development using Jenkins.
6. Explore Docker commands for content management.
7. Develop a simple containerized application using Docker.
8. Integrate Kubernetes and Docker
9. Automate the process of running containerized application developed in program 7 using Kubernetes.
10. Install and Explore Selenium for automated testing.
11. Write a simple program in JavaScript and perform testing using Selenium.
12. Develop test cases for the above containerized application using selenium.

Text Books:

1. *Joakim Verona. Practical Devops, Second Edition. Ingram short title; 2nd edition (2018). ISBN-10: 1788392574*
2. *Deepak Gaikwad, Viral Thakkar. DevOps Tools from Practitioner's Viewpoint. Wiley publications. ISBN: 9788126579952*

References:

1. *Len Bass, Ingo Weber, Liming Zhu. DevOps: A Software Architect's Perspective. Addison Wesley; ISBN-10.*

Suggested Tools*: Git, Jenkins, Docker, Selenium*

R21-BE CSE (IoT-CS-BcT) SEMESTER -VII

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/ Drg	Contact Hrs/ week	CIE	SEE	Duration of SEE (Hrs.)	
Theory Courses										
1	U22PC701CB	IoT Cloud Processing and Security	3	-	-	3	30	70	3	3
2	U22PC702CB	Blockchain Technologies	3	-	-	3	30	70	3	3
3	U22PC703CB	Digital and Mobile Forensics	3	-	-	3	30	70	3	3
4	U22PE74XXX	Professional Elective – IV	3	-	-	3	30	70	3	3
5	U21OE72XXX	Open Elective II	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
6	U22PC781CB	IoT Cloud Processing and Security Lab	-	-	2	2	25	50	3	1
7	U22PC782CB	Blockchain Technologies Lab	-	-	2	2	25	50	3	1
8	U22PW781CB	Capstone Project Work - I	-	-	2	2	50	-	-	1
9	U22PW782CB	Summer Internship	-	-	-	-	50	-	-	1
		Total	**15**	**-**	**6**	**21**	**300**	**450**	**21**	**19**

Professional Elective – IV		
S.No.	**Code**	**Course Title**
1	U22PE741CB	Intellectual Property Rights
2	U22PE742DS	Multicore Architectures and Programming
3	U22PE743CB	Robotic Process Automation
4	U22PE744CB	Security and Privacy in Social Media
5	U22PE745CB	Deep Learning

Open Elective –II		
S.No.	**Code**	**Course Title**
1	U21OE721AE	Automotive Vehicle Maintenance
2	U21OE721CE	Green Building Technologies
3	U21OE721CS	Principles of Operating Systems
4	U21OE721EC	Basic Navigation Systems
5	U21OE722EC	Principles of Mobile Communications
6	U21OE721EE	Non-Conventional Energy Sources
7	U21OE721IT	Fundamentals of Software Engineering
8	U21OE721ME	Entrepreneurship
9	U21OE721MT	Transform Calculus

Course Code	Course Title						Core/ Elective
U22PC701CB	IoT Cloud Processing and Security						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
CN, WT, IoT	3	-	-	-	30	70	3

Course Objectives:

The main objectives of this course are to

1. Understand IoT networking protocols and messaging protocols for effective device communication.
2. Implement IoT architectural components ensuring scalability and interoperability for application development.
3. Identify and utilize appropriate data analytics and visualization tools for IoT data analysis.
4. Gain proficiency in collecting, storing, and analyzing IoT data using exploration, visualization, and statistical techniques.
5. Design data processing pipelines integrating big data technologies for efficient IoT Security on cloud platforms.

Course Outcomes:

After completing this course, the student will be able to:

1. Proficiency in implementing IoT architectural components and protocols for application development.
2. Capability to select and utilize appropriate data analytics and visualization tools based on problem characteristics.
3. Competence in collecting, storing, and analyzing IoT data using diverse techniques and tools.
4. Understanding and application of machine learning techniques, including feature engineering and validation methods, for IoT data analysis.
5. Ability to design and implement data processing pipelines using big data technologies for efficient IoT data storage and analysis on cloud platforms.

UNIT - I

Data Acquiring, Organising, Processing and Analytics: Data Acquiring & Storage, Organizing the Data, Transactions, Business Processes, Integration, Enterprise Systems, Analytics, Knowledge Acquiring, Managing, and Storing Processes

UNIT - II

Data Collection, Storage and Computing Using a Cloud Platform: Cloud Computing Paradigm for Data Collection, Storage and Computing

IoT Cloud-Based Services: AWS IoT Platform, Microsoft Azure IoT Hub, Google IoT, IBM Watson IoT, Cisco IoT Cloud Connect, Blynk, Thingspeak

UNIT - III

Common IoT attack types, Today's IoT attacks: Attacks, Wireless reconnaissance and mapping, Security

protocol attacks, Physical security attacks, Application security attacks
Security Engineering for IoT Development: Building security into design and development, Security in agile developments, Focusing on the IoT device in operation, Secure design

UNIT - IV
The IoT Security Lifecycle: Implementation and integration, Operations and maintenance, Dispose (Secure device disposal and zeroization, Data purging, Inventory control, Data archiving and records management)
Cryptography and its role in securing the IoT, Examining cryptographic controls for IoT protocols (Cryptographic controls built into IoT communication and messaging protocols)

UNIT - V
Cloud IoT security controls: Authentication (and authorization), Software/firmware updates, End-to-end security recommendations, Maintain data integrity, Secure bootstrap and enrollment of IoT devices, Security monitoring
Planning and executing an IoT incident response: Incident response planning, IoT incident response team composition, detection and analysis, containment, eradication, recovery, post-incident activities.

Text Books:-

1. *INTERNET OF THINGS - Architecture and Design Principles, Raj Kamal, Professor, Computer Science and Engineering, Medi-Caps University, Rau, Indore, Madhya Pradesh, India,2022.*
2. *Practical Internet of Things Security, Brian Russell, Drew Van Duren,2016.*

Reference Books:

1. *Madhur Bhargava "IoT Projects with Bluetooth Low Energy, Packt Publishing, August 2017.*
2. *Robin Heydon," Bluetooth Low Energy: The Developer's Handbook", Pearson, October 2012*
3. *Dr.Kumar Saurabh," Cloud Computing", Wiley India, 1st Edition, 2016.*
4. *Robin Heydon," Bluetooth Low Energy: The Developer's Handbook",* Pearson*; 1st edition (8 November 2012).*

e-Resources:
Foundation of Cloud IoT Edge ML, IIT Patna, Prof. Rajiv Misra - https://nptel.ac.in/courses/106104242

Course code	Course Title						Core / Elective
U22PC702CB	**Blockchain Technologies**						Core
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
Cryptography, Web Programming, OOP	3	0	0	0	30	70	3

Course Objectives:

1. To introduce the concept and working model of blockchain
2. To explore the applications and security challenges in blockchain
3. To analyze and learn Ethereum blockchain architecture and its deployment models and familiarize with crypto wallets
4. Learn solidity programming for building smart contracts
5. To explore on Hyperledger fabric framework and its tools

Course Outcomes:

At the end of the course Students will be able to

1. Familiarize on crypto wallets and cryptographic algorithms
2. Understand blockchain fundamentals and build a blockchain network
3. Explore the concepts of Ethereum blockchain network and deploy DApps
4. Implement smart contracts by applying Solidity programming principles
5. Summarize Hyperledger fabric concepts and build applications on it.

UNIT-I

A Short Overview of Cryptography: Fundamentals, Types of Threats, Network Attacks, Private and Public keys, Hashing, Symmetric and Asymmetric algorithms (RSA, Diffie-Hellman, MD5,SHA256), Digital Signatures.

Overview of Cryptocurrencies: Applications: Bitcoins, Dogecoins, Ethers, stablecoins

UNIT-II

Introduction to Blockchain: Overview of Distributed Ledger Technology, Definition, Applications, Architecture, Features, Types and Tools of blockchain, Decentralized Applications (DApps), Consensus mechanisms: PoW, PoS, PoB, PoC, PBFT, Blockchain security, Blockchain Vulnerabilities: sybil attacks, 51% attacks, Double-spending. Overview of Zero-knowledge proofs, Zcash, NFTs

UNIT-III

Solidity Programming: Introduction, solc compiler, Deployment steps, Data types, variables, constants, Immutable, Visibility, payable, if-else statements, while-for loops, Arrays, Mapping, constructors, View and Pure functions, Error Handling, try-catch, sending and receiving ethers

UNIT-IV

Introduction to Ethereum: Ethereum birds eye view, Ethereum versus bitcoin, Ethereum network, Components of Ethereum ecosystem: keys and addresses, Accounts, Transactions and messages, Ether

cryptocurrency/tokens, Ethereum Virtual Machine(EVM), Smart Contracts: Introduction, Writing smart contracts through solidity

UNIT-V

Exploring Hyperledger Fabric: Fundamentals of Hyperledger project, Linux foundation, Hyperledger, Open source and open standards, Hyperledger frameworks, tools, and building blocks, Hyperledger Fabric component Design, Principles of Hyperledger design, CAP Theorem, Hyperledger Fabric reference Architecture, Hyperledger Fabric runtime architecture, Hyperledger Fabric design goals impacting security, Hyperledger Fabric Architecture

Textbooks:

1. *"Mastering Blockchain - Distributed ledger technology, decentralization, and smart contracts explained" by Imran Bashir 2nd edition,Packt Publishing*
2. *"Hands-On Blockchain with Hyperledger - Building decentralized applications with Hyperledger Fabric and Composer" by Nitin Gaur,Luc Desrosiers,Venkatraman Ramakrishna, Packt Publishing.*
3. *Imran Bashir "Mastering Blockchain - Distributed ledger technology, decentralization, and smart contracts explained" by 2nd edition, Packt Publishing, March 2018, ISBN 978-1-78883-904-4*

References:

1. *"Mastering Ethereum Building Smart Contracts and DApps" by Andreas M. Antonopoulos and Dr. Gavin Wood,O'REILLY*
2. *"Cryptography and Network Security - Principles and Practice", Seventh Edition, By Pearson Education.*
3. *Andreas Antonopoulos (Author), Gavin Wood "Mastering Ethereum Building Smart Contracts and DApps", O'REILLY, Paperback, 22 January 2019*

e-Resources:

1. *https://archive.nptel.ac.in/courses/106/105/106105235/*
2. *https://ethereum.org/en/developers/docs/*
3. *https://docs.ethers.org/v5/*
4. *https://hyperledger-fabric.readthedocs.io/en/release-2.5/*
5. *https://solidity-by-example.org/*

Course code	Course Title						Core / Elective
U22PC703CB	Digital and Mobile Forensics						Core
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
LST, OS, CO	3	0	0	0	30	70	3

Course Objectives:

1. To understand the basics digital forensics and techniques.
2. To understand digital crime and investigation
3. To understand how to be prepared for digital forensics readiness.
4. To understand and use forensics tools for IOS devices.
5. To understand use forensics tools for Android devices.

Course Outcomes:

At the end of the course Students will be able to

1. To apply knowledge on digital forensics.
2. To solve about digital crime and investigation.
3. To evaluate digital Forensic Readiness.
4. To analyze identity and extract digital evidence from IOS devices.
5. To justify identity and extract digital evidence from Android devices.

UNIT-I

Introduction To Digital Forensics

Forensic Science – Digital Forensics – Digital Evidence – Digital Forensics Process - Introduction – Identification Phase – Collection Phase – Examination Phase – Analysis Phase – Presentation Phase. Text Book-1(Ch: 1,2)

UNIT-II

Digital Crime And Investigation

Digital Crime – Substantive Criminal Law-General conditions-Offenses-Investigation methods for collecting digital evidence-International Cooperation to collect Digital evidence. Text Book-1(Ch:3(3.3-3.6))

UNIT-III

Digital Forensic Readiness

Introduction – Law Enforcement versus Enterprise Digital Forensic Readiness – Rationale for Digital Forensic Readiness – Frameworks, Standards and Methodologies – Enterprise Digital Forensic Readiness. Text Book-1(Ch:4)

UNIT-IV

IOS Forensics

Mobile hardware and operating system-IOS fundamentals –Jail breaking-File system-HardwareiPhone Security-IOS Forensics -

Procedures and Processes-Tools -Oxygen Forensics – Mobile Edit-iCloud. Text Book-2(Ch:3,5)

UNIT-V

Android Forensics

Android basics – Key Codes – ADB – Rooting Android – Boot Process – File Systems – Security -Tools – Android Forensics – Forensic Procedures – ADB – Android Only Tools – Dual Use Tools -Oxygen Forensics – Mobil Edit – Android App Decompiling. Text Book-2(Ch:4,6)

Text Books

1. *Andre Arnes, Digital Forensics, Wiley, 2018.*
2. *Chuck Easttom, An In-depth Guide to Mobile Device Forensics, First Edition, CRC Press, 2022.*

References

1. *Vacca,J,ComputerForensics,Computer Crime Scene Investigation ,2nd ,Charles River Media,2005 ,ISBN: 1-584450-389.*

e-Resources:

SWAYAM - Digital Forensics By Dr. Jeetendra Pande, Uttarakhand Open University, Haldwani - https://youtube.com/playlist?list=PLfcqoeRp4foVUtkw4tEpN3FqXCGJISqjD&si=aAlnpl2PWt25ILjo

PROFESSIONAL ELECTIVE -IV

Course Code	Course Title						Core/Elective
U22PE741CB	Intellectual Property Rights						Elective
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
	3	-	-	-	30	70	3

Course Objectives:

1. Classify the intellectual property rights to provide the legal rights, patents, trademarks, copyrights and trade secrets.
2. Relate the World Intellectual Property organization to protect intellectual property rules and policies.
3. Identify the world trade organization agreements for trade related intellectual properties rights and investments.
4. Outline the importance of intellectual property in organizations of different industrial sectors for the purpose of product and technology development.
5. Infer the geographical Indications of international development of law for policy and legal issues.

Course Outcomes

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

1. Understand the fundamental concepts and global framework of intellectual property rights.
2. Demonstrate the ability to acquire, evaluate, and register trademarks effectively.
3. Apply the principles of copyright and patent laws to protect original works and inventions.
4. Analyze the laws and litigation processes related to trade secrets and unfair competition.
5. Evaluate recent advancements and international perspectives in various intellectual property domains.

UNIT – I

Introduction to Intellectual property: Introduction, types of intellectual property, international Organizations, agencies and treaties, importance of intellectual property rights.

UNIT – II

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, Selecting, and evaluating trade mark, trade mark registration processes.

UNIT – III

Law of copy rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

UNIT – IV

Trade Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, and protection for submission, trade secrete litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

UNIT – V

New development of intellectual property: new developments in trade mark law; copy right law, patent Law, intellectual property audits. International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

Text Books:

1. *Deborah. E. Bouchoux, Intellectual property right, Cengage learning, ISBN-13 978-1111648572*

Reference Books:

1. *Prabuddha ganguli, Intellectual property right – Unleashing the knowledge economy Tata McGraw Hill Publishing company ltd*

e-Resources:

Intellectual Property Rights and Competition Law, IIT Kharagpur, Prof. KD Raju, Prof. Niharika Sahoo Bhattacharya - https://nptel.ac.in/courses/110105139

Course Code	Course Title						Core / Elective
U22PE742DS	Multicore Architectures and Programming						Elective
	Contact Hours per Week						
Prerequisite	L	T	D	P	CIE	SEE	Credits
PSP, CO, OS	3	-	-	-	30	70	3

Course Objectives

1. Understand the basics of parallel computing and architectures.
2. Explore scalable high-performance computing systems.
3. Analyze clustering models and fault recovery.
4. Examine high-speed networks and message-passing systems.
5. Develop CUDA programming skills for parallel processing.

Course Outcomes

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

1. Explain principles of parallel computing and compare parallel architectures.
2. Analyze scalable parallel architectures and resource management in HPC.
3. Evaluate clustering models and their applications.
4. Implement job scheduling and resource management in high-speed networks.
5. Develop and optimize parallel programs using CUDA and OpenMP.

UNIT-I

Parallel Programming & Computing - Introduction

Era of Computing, Parallel Computing, Multiprocessors and Multicomputer Architectures, Scalar VS Vector Processing, Multivector and Superscalar Machines, Pipelined Processors, SIMD Computers, Conditions of parallelism, Program flow mechanisms, Types of Parallelism – ILP, PLP, LLP, Program Partitioning and scheduling.

UNIT-II

Introduction to High Performance Computing

Era of Computing, Scalable Parallel Computer Architectures, towards low-cost computing, Network of Workstations project by Berkeley, Cluster Computing Architecture, Components, Cluster Middleware and SSI, Need of Resource Management and Scheduling, Programming Environments

UNIT-III

Cluster Computing

Clustering Models, Clustering Architectures, Clustering Architectures key factors, types of clusters, Mission critical Vs Business Critical Applications, Fault Detection and Masking Algorithms, Check pointing, Heartbeats, Watchdog Timers, Fault recovery through Failover and Failback Concepts

UNIT-IV

High Speed Networks & Message Passing

Introduction to High-Speed Networks, Lightweight Messaging Systems, Xpress Transport Protocol, Software RAID and Parallel File systems, Load Balancing Over Networks – Algorithms and Applications, Job Scheduling approaches and Resource Management in Cluster.

UNIT-V

CUDA Programming:

Introduction to CUDA architecture for parallel processing, CUDA Parallelism Model, Foundations of Shared Memory, Introduction to CUDA-C, Parallel programming in CUDA-C, Thread Cooperation and Execution Efficiency, Constants memory and events, memory management, CUDA C on multiple GPUs, Hashing and Natural Parallelism, Scheduling and Work Distribution, Atomics, Barriers and Progress, Transactional Memory.

Introduction to OpenCL and OpenMP, Parallel Programming using OpenMP.

Text Books

1. *Rajkumar, High Performance Cluster Computing: Architectures and Systems, Vol. 1 Pearson Education*
2. *Georg Hager and Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, CRC Press*

Reference Books

1. *Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw Hill International Editions.*

e-Resources:

Parallel Computer Architecture, IIT Guwahati, Prof. Hemangee K. Kapoor - https://nptel.ac.in/courses/106103359

Course Code	Course Title						Core/Elective
U22PE743CB	Robotic Process Automation						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
PSP, DSA, SE, DBMS	3	-	-	-	30	70	3

Course Objectives:

1. To understand basic concepts of RPA
2. To describe IIPA, where it can be applied and how it implemented.
3. To describe the different types of variables, Control Flow and data manipulation techniques
4. To Understand Image, Text and data Tables Automation
5. To describe various types of Exceptions and strategies to handle.

Course Outcomes:

Student will be able to:

1. To Understand the basic concepts of RPA
2. To describe various components and platforms of RPA.
3. To describe the different types of variables, control flow and data manipulation techniques.
4. To understand various control techniques and OCR in RPA.
5. To describe various types and strategies to handle

UNIT-I

RPA Foundations- What is RPA - flavors of RPA- history of RPA- The Benefits of RPA- The downsides of RPA- RPA Compared to BPO, BPM and BPA - Consumer Willingness for Automation- The Workforce of the Future- RPA SkillsOn-Premise Vs. the Cloud- Web Technology- Programming Languages and Low Code- 0CR-Databases-APls- AlCognitive Automation-Agile, Scrum, Kanban and Waterfall Devops- Flowcharts.

UNIT-II

RPA Platforms- Components of RPA- RPA Platforms-About Ui Path- About UiPath - The future of automation - Record and PIay - Downloading and installing UiPath Studio -Learning Ui Path Studio- - Task recorder - Step-by step examples using the recorder.

UNIT-III

Sequence, Flowchart, and Control Flow-sequencing the workflow- Activities-Control flow, various types of loops, and decision making-Step-by step example using Sequence and Flowchart-Step-by-step example using Sequence and Control Flow-Data Manipulation-Variables and Scope Collections-Arguments - Purpose and use-Data table usage with examples Clipboard Management-File operation with step-by-step example-CSV/Excel to data table and vice versa (with a step-by-step example)**.**

UNIT-IV

Taking Control of the Controls- Finding and attaching windows- Finding the 08 control- Techniques for waiting for a control- Act on controls - mouse and keyboard activities- Working with Ui Explorer-

Handling events- Revisit recorder-Screen Scraping- When to use OCR- Types of 0CR available- How to use 0CR- Avoiding typical failure points.

UNIT-V

Exception Handling, Debugging, and Logging- Exception handling- Common exceptions and ways to handle themLogging and taking screenshots Debugging techniques- Collecting crash dumps- Error reporting- Future of RPA

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Text Books:

1. *Tom Taulli, The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems,2020, lSBN-13 (electronic):978-7-4842-5729-6, Publisher: A press*
2. *Alok Mani Tripathi, Learning Robotic Process Automation, Publisher: Packt Publishing Release Date: March 2018 ISBN: 9787788470940*

Reference Books:

1. *Frank Casale, Rebecca Dilla, Iieidi Jaynes,Lauren Livingston," lntroduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation.*
2. *Richard Murdoch, Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant*
3. *Srikanth Merianda, Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation*

Web Resources:

1. *Learning Robotic Process Automation, https://www.packtpub.com/in/business/learning-robotic-processautomation*
2. *Automation Anywhere University, https://university.automationanywhere.com/*
3. *https://www.urbanpro.com/ghaziabad/rpa-robotics-process-automation-automation-anywhere/11461411*
4. *Robotic Process Automation Full Course - 10 Hours | RPA Tutorial For Beginners | Edureka - https://www.youtube.com/watch?v=MBl-3Yb30FA*

Course Code	Course Title						Core / Elective
U22PE744CB	Security and Privacy in Social Media						Elective
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
CN, OS, Cyber Security	3	-	-	-	30	70	3

Course Objectives:

1. Understand and analyze the fundamental principles of security and privacy in online social media networks.
2. Identify and evaluate common security threats and vulnerabilities in social media platforms.
3. Develop strategies to protect personal data and maintain user privacy in online social interactions.
4. Explore the legal, ethical, and social implications of privacy breaches in social media networks.
5. Implement practical techniques and tools for enhancing security and privacy in online social media environments.

Course Outcomes:

On completion of this course, the student will be able to-

1. Understand and analyze social media content using foundational techniques like BoW and TF-IDF.
2. Apply network analysis concepts to examine the structure and dynamics of social media networks.
3. Identify and address various security threats in social media, including identity theft and misinformation.
4. Evaluate privacy concerns and implement measures to protect user data on social media platforms.
5. Analyze real-world social media platforms through comprehensive case studies to understand their unique features and challenges.

UNIT-I

Social Media - Introduction; Social Media - User vs Developer's Perspective, Data Collection APIs; Social Media Content Analysis - BoW Model, TF-IDF

UNIT-II

Network Analysis - Node Centrality Measures, Degree Distribution, Average Path Length, Clustering Coefficient, Power Law; Synthetic Networks - Random Graphs, Preferential Attachment Model.

UNIT-III

Security Issues in Social Media - Overview; Review of Machine Learning; Identity Theft - Profile Cloning, Social Phishing; Fake, Compromised, Sybil accounts and their behavior; Spamming; Rumour or Misinformation; Cyberbullying; Collective Misbehaviors.

UNIT-IV

Privacy Issues in Social Media - Overview; Privacy Settings; PII Leakage, Identity vs Attribute Disclosure Attacks; Inference Attacks; De-anonymization Attacks; Privacy Metrics - k-anonymity, l-diversity; Personalization vs Privacy, Differential Privacy.

UNIT-V

Social Media Case Studies - Facebook, Twitter, Instagram, YouTube, LinkedIn, StackOverflow, GitHub, Quora, SnapChat, Reddit, FourSquare, Yelp.

Text Book(s):

1. *Zafarani, Reza, Mohammad Ali Abbasi, and Huan Liu. Social media mining: an introduction. Cambridge University Press*

Suggested Reference(s):

1. *Bonzanini Marco. Mastering Social Media Mining. Packt Publishing*
2. *Mikhail Klassen, Matthew A. Russell. Mining the Social Web, O'Reilly Media*
3. *Privacy and Security in Online Social Media (PSOSM), Prof. Ponnurangam Kumaraguru, IIITH, https://cdn.iiit.ac.in/cdn/precog.iiit.ac.in/teaching/psosmonnptel/2023/*
4. *NOC:Privacy and Security in Online Social Media, IIIT Hyderabad, Prof. Ponnurangam Kumaraguru, https://nptel.ac.in/courses/106106146*

Suggested MOOC(s)/Value Added Course(s):

1. *Privacy and Security in Online Social Media, Prof. Ponnurangam Kumaraguru, IIIT Hyderabad, https://onlinecourses.nptel.ac.in/noc23_cs13*

Course Code	Course Title						Core/ Elective
U22PE745CB	Deep Learning						Elective
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
Machine Learning	3	-	-	-	30	70	3

Course Objectives:

1. Understand the fundamentals of neural networks.
2. Know issues in optimization of neural networks algorithms and understand regularization.
3. Learn about network architectures such as convolutional neural networks, recurrent neural networks and long short term memory cells.
4. Understand the application of deep networks to Computer Vision, NLP
5. Learn about adversarial learning models.

Course Outcomes: On completion of this course, the student will be able to-

1. Demonstrate the fundamentals of neural networks and their training.
2. Illustrate the optimization methods for deep neural networks.
3. Differentiate between various architectures of CNNs, RNN
4. Apply the relevant architecture to applications of Computer Vision and NLP
5. Illustrate architecture of GANs and their applications

UNIT-I

Introduction: History of Deep Learning, McCulloch Pitts Neuron, Multilayer Perceptrons (MLPs), Sigmoid Neurons, Feed Forward Neural Networks, Back propagation

UNIT-II

Activation functions: Sigmoid, ReLU, Hyperbolic Functions, Softmax

Optimization: Types of errors, bias-variance trade-off, overfitting-underfitting, Cross Validation, Feature Selection, Gradient Descent (GD), Momentum Based GD, Stochastic GD, Regularization (dropout, drop connect, batch normalization), Hyper parameters

UNIT-III

Introduction to CNNs, Architecture, Convolution/pooling layers, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet.

Vision Application: Object Detection – As classification, region proposals, RCNN, YOLO architectures

UNIT-IV

Introduction to RNNs, basic building blocks of RNNs and other architectural details, GRU, LSTMs
Encoder Decoder Models, Seq2Seq models
NLP application: Language Translation (Machine Translation) - Attention mechanism.

UNIT-V

Adversarial Learning Models: Generative and discriminative models, Architectural and training details of Generative Adversarial Networks (GANs), Loss functions, Conditional GAN, RC GAN
Vision Application: Image to Image Translation – pix2pix GAN

Text Books:

1. *Ian Goodfellow, YoshuaBengio, Aaron Courville. Deep Learning, the MIT press, 2016*

Reference Books:

1. *Bengio, Yoshua. " Learning deep architectures for AI." Foundations and trends in Machine Learning 2.1, Now Publishers, 2009*
2. *Deep Learning, Rajiv Chopra, Khanna Book Publishing, Delhi 2020.*

e-Resources:

1. *https://nptel.ac.in/courses/106/106/106106184/*
2. *https://www.coursera.org/specializations/deep-learning*

Open Elective –II

Course Code	Course Title						Core/ Elective
U21OE721AE	Automotive Vehicle Maintenance						Open Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives:

It is intended to make the students to:

1. To study basic types of vehicle maintenance along with its importance
2. To understand the trouble diagnosis procedure for electrical andelectronic systems in automobiles
3. To know the dismantling and service procedure of drive line system
4. To acquaint with various Trouble shooting, fault tracing practices available in automobile industry
5. To understand the maintenance procedure for air-conditioning in automobiles

Course Outcomes:

After completing this course, the student will be able to:

1. Demonstrate the maintenance procedure for automotive Engine and prepare checklist.
2. Illustrate the trouble diagnosis procedure for electrical systems like Battery, Starting Systems
3. Identify the trouble diagnosis procedure for steering and suspension system.
4. Illustrate trouble diagnosis procedure for lubrication and fuel delivery system.
5. Explain trouble diagnosis procedure for heating system of automobile.

UNIT-I

Maintenance, workshop practices, safety and tools maintenance: Need, importance, primary and secondary functions, policies - classification of maintenance work - vehicle insurance - basic problem diagnosis. Automotive service procedures – workshop operations.

–workshop manual - vehicle identification. Safety – Personnel, machines and equipment, vehicles, firesafety - First aid. Basic tools – special service tools – measuring instruments

–condition checking of seals, gaskets and sealants. Scheduled maintenance services – service intervals - Towing and recovering.

UNIT-II

Engine and engine subsystem maintenance: General Engine service- Dismantling of Engine components Engine repair- working on the underside, front, top, ancillaries- Service of basic engine parts, cooling and lubricating system, fuel system, Intake and Exhaust system, electrical system - Electronic fuel injection

and engine management. Service - fault diagnosis- servicing emission controls.

UNIT-III

Transmission and driveline maintenance: Clutch- general checks, adjustment and service- Dismantling, identifying, checking and reassembling transmission, - road testing- Removing and replacing propeller shaft, servicing of cross and yoke joint and constant velocity joints- Rear axle service points- removing axle shaft and bearings- servicing differential assemblies- fault diagnosis.

UNIT-IV

Steering, brake, suspension and wheel maintenance: Inspection, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake, Parking brake. Bleeding of brakes. Inspection, Maintenance and Service of Mc person strut, coil spring, leaf spring, shock absorbers. Dismantling and assembly procedures. Wheel alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation. Inspection, Maintenance and Service of steering linkage, steering column, Rack and pinion steering, Recirculating ball steering service- Worm type steering, power steering system.

UNIT-V

Auto electrical and air conditioning maintenance: Maintenance of batteries, starting system, charging system and body electrical -Fault diagnosis using Scan tools. Maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator - Replacement of hoses- Leak detection- AC Charging Fault Diagnosis Vehicle body repair like panel beating, tinkering, soldering, polishing, painting.

Suggested Reading:

1. *Ed May, "Automotive Mechanics Volume One, McGraw Hill Publications, 2003*
2. *Ed May, "Automotive Mechanics Volume Two, McGraw Hill Publications, 2003*
3. *Vehicle Service Manuals of reputed manufacturers Bosch Automotive Handbook, Sixth Edition, 2004.* Green Building Technology

Course Code	Course Title						Core/Elective
U21OE721CE	Green Building Technologies						Open Elective
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			Credits
	3	-	-	-	30	70	3

Course Objectives: The objective of this course is to impart knowledge on,

1. Principles of green building technologies and rating systems
2. The principles of effective energy and resources management in buildings
3. The methodologies to reduce, recycle and reuse towards sustainability.

Course Outcomes: After completing this course the students, will be able to

1. Classify the various features, benefits, and rating systems for a green building
2. Outline the criteria used for site selection and water efficiency methods
3. Select the energy efficiency techniques in designing a green building
4. Select materials for sustainable built environment & adopt waste management methods
5. Identify an appropriate method for maintaining indoor environmental quality in a green building

UNIT-I

Introduction to Green Buildings: Definition of green buildings and sustainable development, typical features of green buildings, benefits of green buildings towards sustainable development. Green building rating systems – GRIHA, IGBC and LEED, overview of the criteria as per these rating systems

UNIT- II

Site Selection and Planning: Criteria for site selection, preservation of landscape, soil erosion control, minimizing urban heat island effect

Water Conservation and efficiency: Rainwater harvesting methods for roof & non roof, reducing landscape water demand by proper irrigation systems, water efficient plumbing systems, water metering, waste water treatment, recycle and reuse systems

UNIT-III

Energy Efficiency: Environmental impact of building constructions, Concepts of embodied energy, operational energy and life cycle energy.

Methods to reduce operational Energy: Energy efficient building envelopes, efficient lighting technologies, energy efficient appliances for heating and air- conditioning systems in buildings, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring concept of net zero buildings.

UNIT-IV

Building Materials: Methods to reduce embodied energy in building materials: (a) Use of local building materials (b) Use of natural and renewable materials (c) Use of materials with recycled content such as blended cements materials from agro and industrial waste (d) Reuse of waste and salvaged materials.

Waste Management: Handling of construction waste materials, separation of household waste, on-site and off-site organic waste management.

UNIT-V

Indoor Environmental Quality for Occupant Comfort and wellbeing: Day lighting, air ventilation, exhaust systems, low VOC paints, materials & adhesives, building acoustics, Codes related to green buildings: NBC, ECBC, ASHRAE, UPC etc.

Text Books:

1.G. D. Rai, Non-Conventional Energy Resources, Khanna Publishers, 1988.
2.K.S. Jagadish, B.V. Venkatarama Reddy and K.S. Nanjunda Rao, Alternative building materials and Technologies, New Age International, 2017

Reference Books:

1.IGBC Green Homes Rating System, Version 2.0., Abridged reference guide, 2013, Indian Green Building Council Publishers
2.GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment
3.Sustainable Building Design Manual, Vol.1 and 2, TERI, New Delhi 2004

Course Code	Course Title						Core/ Elective
U21OE721CS	Principles of Operating Systems						Open Elective
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
----	3		-	-	30	70	3

Course Objectives

1. To learn the fundamentals of Operating Systems.
2. To learn the mechanisms of OS to handle processes and threads and their communication.
3. To learn the mechanisms involved in memory management in contemporary OS.
4. To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection.
5. To know the components and management aspects of concurrency management.

Course Outcomes

After completing this course, the student will be able to:

1. Identify System calls and evaluate process scheduling criteria of OS.
2. Develop procedures for process synchronization of an OS.
3. Demonstrate the concepts of memory management and of disk management.
4. Solve issues related to file system interface and implementation, I/O systems.
5. Describe System model for deadlock, Methods for handling deadlocks.

UNIT-I

Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine.

UNIT-II

Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching

Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads, Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling Criteria, Scheduling algorithms, multiprocessor scheduling.

UNIT-III

Process Synchronization: Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Peterson‘s Solution, classical problems of synchronization: The Bounded buffer problem, Producer\Consumer Problem, reader‘s & writer problem, Dinning philosopher‘s problem. Semaphores, Event Counters, Monitors, Message Passing, Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Methods for Handling: Deadlocks: Deadlock prevention, Deadlock Avoidance: Banker‘s algorithm, Deadlock detection and Recovery.

UNIT-IV

Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation, fragmentation, and Compaction; Paging: Principle of operation – Page allocation – Hardware support for paging, structure of page table,Protection and sharing, Disadvantages of paging.

Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page/Dirty bit – Demand paging, Page Replacement algorithms, Trashing.

UNIT-V

I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software,

File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods, Free-space management, directory implementation, efficiency, and performance.

Secondary-Storage Structure: Disk structure, Disk scheduling algorithms, Disk Management, RAID structure.

Suggested Readings:

1. *Avi Silberschatz, Peter Galvin, Greg Gagne, Operating System Concepts Essentials, 9th Edition, Wiley Asia Student Edition, 2017.*
2. *William Stallings, Operating Systems: Internals and Design Principles, 5th Edition, Prentice Hall of India, 2016.*
3. *Maurice Bach, Design of the Unix Operating Systems, 8th Edition, Prentice-Hall of India, 2009.*
4. *Daniel P. Bovet, Marco Cesati, Understanding the Linux Kernel, 3rd Edition, , O'Reilly and Associates.*

Course code	Course Title						Core/ Elective
U21OE721EC	Basic Navigation Systems						Open Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives:

1. To understand fundamentals of Navigation.
2. To understand the Fundamentals of Global Position System (GPS) and its errors.
3. To study architectures of different GPS based augmentation systems.
4. To learn the basic concepts of Indian Navigation Systems and applications.
5. To learn the basic concepts of other (Global Navigation Satellite Systems (GNSS) and Regional based navigation systems.

Course Outcomes:

1. Familiarize with the fundamentals of Navigation.
2. Understanding GPS architecture.
3. Describe the different types of augmentation systems.
4. Analyze the Indian Navigation Systems.
5. Understanding various GNSS and Regional Navigation satellite systems.

UNIT-I

Introduction : History of Navigation, History of Time, Satellite Navigation and Position Systems, Steps in Position Determination, Solar and Sidereal day, GPS and Universal Time Coordinated (UTC) time.

UNIT–II

GPS Fundamentals: GPS Constellation, Principle of operation, GPS Orbits
Dilution of Precision (DOP): (Geometric DOP) GDOP, Verticle DOP (VDOP) and Position DOP (PDOP).GPS Signal Structure, Coarse Acquisition (C/A) and Precise (P) - Codes, GPS Errors, User Equivalent Range Error (UERE)

UNIT-III

GPS Augmentation systems: Classification of Augmentations Systems, Relative advantages of SBAS and GBAS, Wide area augmentation system (WAAS) architecture, Local area augmentation system (LAAS) concept, European Geostationary Navigation Overlay Service (EGNOS) and MTSAT Satellite-based Augmentation System (MSAS).

UNIT-IV

Indian Navigation Systems: GPS Aided GEO Augmented Navigation (GAGAN), Architecture and features of Indian Regional Navigation Satellite System (IRNSS), GNSS Applications.
GPS Integration: GPS/Geograpic Information System (GIS), GPS/Inertial Navigation Systems (INS), GPS/Pseudolite, GPS/Cellular integrations.

UNIT–V

Other GNSS Systems: Architecture and features of Russian GLObal NAvigation Satellite System GLONASS (Globalnaya Navigazionnaya Sputnikovaya Sistema), European Navigation System (Galileo), Chinese Global Navigation System (BieDou-2/Compass)

Other Regional Navigation Satellite Systems (RNSS) : Japan's Quasi-Zenith Satellite System (QZSS), Chinese Area Positioning System (CAPS).

Text Books :

1. *Rao G.S., "Global Navigation Satellite Systems – with Essentials of Satellite Communications", TMH.*
2. *Sateesh Gopi, "Global Positioning System: Principles and Applications", TMH.*

References :

1. *Elliot D. Kaplan, "Understanding GPS Principles and Applications", Artech House.*

Course Code	Course Title						Core/ Elective
U21OE722EC	Principles of Mobile Communications						Open Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
DC	3	-	-	-	30	70	3

Course Objectives:

1. To understand the technology trends changing from generation to generation.
2. To have an insight into the various propagation models and the effects of fading.
3. To understand the multiple access techniques and Mobile communication system specifications.

Course Outcomes:

On completion of the course, students will be able to

1. Analyze various methodologies to improve the cellular capacity.
2. Identify various Propagation effects.
3. Identify the effects of fading and multi path propagation.
4. Categorize various multiple access techniques for Mobile Communications.
5. Analyze the specifications of GSM based Mobile Communication Systems.

UNIT-I

Introduction to Wireless Communication Systems: Evolution of Mobile Radio Communications, Examples of Wireless Communications Systems, Trends in Cellular Radio and Personal Communication Systems.

Fundamental Concepts of Cellular system design: Introduction Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interference and System Capacity, Improving Coverage and Capacity in Cellular Systems.

UNIT-II

Mobile Radio Propagation - Large Scale Path Loss: Introduction to Radio wave Propagation, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering.

UNIT-III

Mobile Radio Propagation - Small Scale Fading and Multipath: Small Scale Multipath Propagation, Parameters of Mobile Multipath Channels, Types of Small-Scale Fading, Cell tower antenna and radiation patterns, mobile antennas and radiation patterns.

UNIT-IV

Multiple Access Techniques for Wireless Communications: Qualitative treatment on Frequency Division Multiple Access (FDMA), Time Division Multiple Access TDMA), Code Division Multiple Access (CDMA) and Space Division Multiple Access (SDMA).

UNIT-V

Wireless Systems and Standards: Global System for Mobile (GSM) – Services and features, System architecture, GSM Radio subsystem, channel types, Frame structure for GSM.

Textbooks:

1. *Theodore S. Rappaport, "Wireless Communications Principles and Practices", 2nd edition, Pearson Education.*

Reference books:

1. *David Tse, Pramodh Viswanath, "Fundamentals of Wireless Communication", 2005, Cambridge University Press.*

Course Code	Course Title						Core/ Elective
U21OE721 EE	Non-Conventional Energy Sources						Open Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
	3	-	-	-	30	70	3

COURSE OBJECTIVES

1. To impart the knowledge of basics of different non-conventional types of power generation & power plants in detail
2. Understanding the need and role of Non-Conventional Energy sources particularly when the conventional sources are scarce in nature

COURSE OUTCOMES

At the end of the course students will be able to

1. Understand the different nonconventional sources and the power generation techniques to generate electrical power.
2. Understand the Solar energy power development and different applications.
3. Understand different wind energy power generation techniques and applications.
4. Design a prescribed engineering sub-system
5. Recognize the need and ability to engage in lifelong learning for further developments in this field.

UNIT-I

Review of Conventional and Non-Conventional energy sources - Need for non- conventional energy sources Types of Non- conventional energy sources - Fuel Cells - Principle of operation with special reference to H2 °2 Cell - Classification and Block diagram of fuel cell systems - Ion exchange membrane cell - Molten carbonate cells - Solid oxide electrolyte cells - Regenerative system- Regenerative Fuel Cell - Advantages and disadvantages of Fuel Cells-Polarization - Conversion efficiency and Applications of Fuel Cells.

UNIT-II

Solar energy - Solar radiation and its measurements - Solar Energy collectors -Solar Energy storage systems - Solar Pond - Application of Solar Pond - Applications of solar energy.

UNIT-III

Wind energy- Principles of wind energy conversion systems - Nature of wind - Power in the Wind-Basic components of WECS -Classification of WECS -Site selection considerations - Advantages and disadvantages of WECS -Wind energy collectors -Wind electric generating and control systems - Applications of Wind energy -Environmental aspects.

UNIT-IV

Energy from the Oceans - Ocean Thermal Electric Conversion (OTEC) methods - Principles of tidal power generation -Advantages and limitations of tidal power generation -Ocean waves - Wave energy conversion devices -Advantages and disadvantages of wave energy - Geo-Thermal Energy - Types of Geo-Thermal Energy Systems - Applications of Geo- Thermal Energy.

UNIT-V

Energy from Biomass - Biomass conversion technologies / processes - Photosynthesis - Photosynthetic efficiency - Biogas generation - Selection of site for Biogas plant - Classification of Biogas plants - Details of commonly used Biogas plants in India - Advantages and disadvantages of Biogas generation - Thermal gasification of biomass - Biomass gasifiers.

Text Books:

1. *Rai G.D, Non-Conventional Sources of Energy, Khandala Publishers, New Delhi, 1999.*
2. *David M Buchla and Thomas E Kissell, Renewable Energy Systems, 1st Edition by, Pearson India.*

Reference Books:

1. *M.M. El-Wakil, Power Plant Technology. Mc-Graw Hill, 1984.*

Course Code	Course Title						Core/ Elective
U21OE721IT	Fundamentals of Software Engineering						Open Elective
Pre requisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

The student will be able

1. To introduce the basic concepts of software development processes from defining a product to shipping and maintaining.
2. To impart knowledge on various phases, methodologies and practices of software development.
3. To understand the importance of testing in software development, study various testing strategies along with its relationship with software quality and metrics.

Course Outcomes :

After completing this course the student will be able to:

1. Understand importance of process models and agile view of process
2. Understand and learn requirements generation process
3. Understand and learn about behavioral models of software engineering
4. Learn various architectural styles and patterns involved in software design
5. Learn basics of software testing and quality assurance

UNIT-I

Introduction to Software Engineering

A generic view of Process: Software Engineering, Process Framework, CMM Process Patterns, Process Assessment.

Process Models: Prescriptive Models, Waterfall Model, Incremental Process Models, Evolutionary Process Models, Specialized Process Models, The Unified Models, Personal and Team Process Models, Process Technology, Product and Process.

An Agile view of Process: Introduction to Agility and Agile Process, Agile Process Models

UNIT-II

Software Engineering Principles: SE Principles, Communication Principles, Planning Principles, Modeling Principles, Construction Principles, Deployment.

System Engineering: Computer-based Systems, The System Engineering Hierarchy, Business Process Engineering, Product Engineering, System Modeling.

Requirements Engineering: A Bridge to Design and Construction, Requirements Engineering Tasks, Initiating Requirements Engineering Process, Eliciting Requirements, Developing Use-Cases, Building the Analysis Model, Negotiating Requirements, Validating Requirements.

UNIT-III

Building the Analysis Model: Requirements Analysis Modeling Approaches, Data Modeling Concepts,

Object-Oriented Analysis, Scenario-based Modeling, Flow-oriented Modeling, Class-based Modeling, Creating a Behavioral Model.
Design Engineering: Design within the context of SE, Design Process and Design Quality, Design Concepts, The Design Model, Pattern-based Software Design.

UNIT-IV
Creating an Architectural Design: Software Architecture, Data Design, Architectural Styles and Patterns, Architectural Design.
Modeling Component-Level Design: Definition of Component, Designing Class-based Components, Conducting Component-level Design, Object Constraint Language, Designing Conventional Components.
Performing User Interface Design: The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation.

UNIT-V
Testing Strategies: A Strategic Approach to Conventional Software Testing, Test Strategies for O-O Software.
Tactics: Software Testing Fundamentals, Black-box and White-box Testing, Basis Path Testing, Control Structure Testing, O-O Testing Methods.
Debugging: Debugging Techniques, The Art of Debugging.
Product Metrics: A Framework for Product Metrics, Metrics for each phase of software development.
Software Quality: Definition
Quality Assurance: Basic Elements, Formal Approaches, Statistical Software Quality Assurance, Software Reliability, ISO-9000 Quality Standards, SQA Plan.

Text Books:

1. *RogerS.Pressman,SoftwareEngineering:APractitioner'sApproach,7thEdition,McGraw Hill, 2009*
2. *AliBehforoozandFrederickJ.Hudson,SoftwareEngineeringFundamentals,OxfordUnive rsityPress, 1996*

Course Code	Course Title						Core / Elective
U21OE721ME	Entrepreneurship						Open Elective
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	P	D			
Operations Research, Industrial Engineering	3	-	-	-	30	70	3

Course Objectives

The objectives of this course are to

1. Learn nuances of starting an enterprise & project management.
2. Understand the behavioral aspects of entrepreneurs and time management.
3. Motivate students to take up entrepreneurship in future.

Course Outcomes

On completion of course, students will be able to

1. Distinguish the forms of Enterprises with respect to Indian Industrial Environment and analyse the linkage among small, medium and heavy industries.
2. Recall the emergence of entrepreneurs and examine the importance of idea generation and choice of technology for success of an enterprise.
3. Interpret project financing in India and assess the viability of a project in terms of market demand, financial resources, profitability aspects and technical feasibility.
4. Analyse the techniques of CPM, PERT and solve problems related to project management.
5. Examine the behavioral aspects of entrepreneurs and compare the approaches of time management.

UNIT-I

Indian Industrial Environment- competence, Opportunities and Challenges. Entrepreneurship and Economic growth. Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries. Types of enterprises.

UNIT-II

Identification and characteristics of entrepreneurs: Emergence of First generation entrepreneurs, environmental influence and women entrepreneurs. Conception and evaluation of ideas and their sources. Choice of Technology - Collaborative interaction for Technology development.

UNIT-III

Project Formulation: Analysis of market demand, Financial and profitability analysis and technical analysis, project financing in India.

UNIT-IV

Project Management: Project management during construction phase, project organization, project planning and control using CPM, PERT techniques. Human aspects of project management. Assessment of tax burden.

UNIT-V

Behavioural aspects of entrepreneurs: Personality - determinants, attributes and models. Leadership concepts and models. Values and attitudes. Motivation aspects. Change behaviour.

Time Management: Various approaches of time management, their strengths and weaknesses. The urgency addiction and time management matrix.

Text Books:

1. *Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya Publishing House, 1997.*
2. *Project-Planning, Analysis, Selection, Implementation and Review, Prasanna Chandra, Tata McGraw-Hill Publishing Company Ltd. 1995.*
3. *First Things First, Stephen R. Covey and A. Roger Merrill, Simon and Schuster Publication, 1994.*

Reference Books:

1. *Entrepreneurship, Robert D. Hisrich, Michael P. Peters, Tata McGraw Hill Publishing Company Ltd., 5th Edition, 2005.*
2. *Organizational Behaviour, G.S. Sudha, National Publications, United Kingdom, 1996.*

Course Code	Course Title						Core / Elective
U21OE721MT	Transform Calculus (Common to All Branches)						Open Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3		-	-	30	70	3

Course Objectives:

1. To Study Laplace Transforms and its properties.
2. To Study Inverse Laplace transforms and it's Applications.
3. To Study Z- Transforms and its properties.
4. To Study Inverse Z transforms and it's Applications.
5. To study Fourier series.

Course Outcomes:

The students will be able to

1. Solve problems based on Laplace transforms and its properties.
2. Solve problems on Inverse Laplace Transforms and Ordinary Differential Equations.
3. Solve problems based on Z- transforms and its properties.
4. Solve problems on Inverse Z-Transforms and Difference Equations.
5. Develop a Fourier series for a given function in various intervals.

UNIT-I

Laplace Transforms: Introduction, Kernel of Laplace Transforms, Transforms of elementary functions, Properties of Laplace Transforms, Transforms of derivatives, Transforms of Integrals, Multiplication by t, Division by t.(without proofs)

UNIT-II

Inverse Laplace Transforms: Definition, elementary functions, Partial fractions method, Convolution Theorem (Without proof), Solutions of ordinary Linear differential equations with Constant Coefficients(Initial value problems) using Laplace transforms.

UNIT-III

Z-Transforms: Introduction, Basic Theory, Some standard sequences, Existence, Linearity Property, Scaling property, Shifting theorem, Initial and Final Value theorems, Differentiation (without proofs).

UNIT-IV

Inverse Z-Transforms: Definition, Some standard functions, Partial fractions method, Convolution theorem(without proof), Solution of Linear difference equations with constant coefficients using Z-transforms.

UNIT-V

Fourier Series and Fourier Transforms: Introduction to Fourier series, Expansion of a function in Fourier Series for a given range, Change of interval, Half-range sine and cosine series. Introduction to Fourier Transforms, Definition of Fourier Transform, Fourier sine and cosine Transforms, Properties of Fourier Transforms-Linearity property, Change of scale property, Shifting property, Modulation theorem(without proofs)

Text books:

1. *R.K. Jain & S.R.K Iyengar, Advanced Engineering Mathematics, Narosa Publications,5th Edition 2016.*
2. *B.S. Grewal, Higher Engineering Mathematics, Khanna Publications, 44th Edition, 2018.*

Suggested Readings:

1. *B.V. Ramana, Higher Engineering Mathematics, McGraw Hill Education, 23rd reprint, 2015.*
2. *N. Bali, M. Goyal, A text book of Engineering Mathematics, Laxmi publications,2010*
3. *Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley, 9th Edition, 2012.*
4. *Ian N. Sneddon, The Use of Integral Transforms, Tata McGraw-Hill,1974.*

Course Code	Course Title						Core/ Elective
U22PC781CB	IoT Cloud Processing and Security Lab						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
CN, WT, IoT		-	2		25	50	1

Course Objectives:

The main objectives of this course are to

1. Arrange IoT devices with sensors for environmental monitoring.
2. Establish data collection and transmission from IoT devices to cloud platforms.
3. Utilize cloud storage for scalable IoT data management.
4. Implement real-time data processing for IoT data analysis.
5. Develop web dashboards for visualizing IoT data insights.

Course Outcomes:

After completing this course, the student will be able to:

1. Configure IoT devices with integrated sensors for operational use.
2. Design and implement efficient data collection from IoT devices to a cloud platform.
3. Set up secure cloud storage solutions for IoT data.
4. Develop data processing pipelines for real-time analysis of IoT data streams.
5. Create interactive web dashboards for visualizing real-time and historical IoT data.

List of Experiments:

1. **IoT Device Setup and Configuration**: Configure and set up a basic IoT device (like Raspberry Pi or Arduino) with sensors (e.g., temperature, humidity).
2. **Data Collection and Transmission**: Design and implement a data collection system from IoT devices to a cloud platform.
3. **Cloud Data Storage and Processing**: Set up cloud storage for storing IoT data.
4. Implement data processing to analyze and transform incoming IoT data streams.
5. **IoT Data Visualization**: Develop a web-based dashboard to visualize real-time and historical IoT data.
6. Incorporate alert mechanisms based on thresholds and anomalies in the data.
7. **Secure Communication Protocols**: Ensure secure transmission of sensor data using encryption techniques.
8. **IoT Device Authentication and Access Control**: Implement device authentication mechanisms for accessing cloud services.
9. Set up role-based access control (RBAC) for IoT devices and cloud resources.
10. **IoT Device Security**: Explore common vulnerabilities in IoT devices (e.g., insecure firmware, default credentials).

Suggested Tools: *ArduinoIDE, CISCO Packet Tracer, PythonAnywhere, MySQL*

Course code	Course Title						Core/ Elective
U22PC782CB	Blockchain Technologies Lab						Core
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
OOPJ, WT, Cryptography	0	0	0	2	25	50	1

Course Objectives:

1. To analyze different cryptographic tools
2. To explore online crypto wallets and perform transactions
3. To learn solidity programming concepts
4. To workout with various public and private Blockchain frameworks and tools
5. To build a Decentralized applications in a blockchain test networks

Course Outcomes:

At the end of the course students will be able to

1. Analyze different cryptographic tools
2. Perform transactions through online crypto wallets
3. Build and deploy Solidity programs
4. Design smart contracts for blockchain test networks
5. Practice Decentralized Applications in public and private blockchain test networks

Week - 1: Basic Cryptographic tools

Generating ciphertexts from plaintexts, digital signatures through public and private keys, Hash functions, Showing a live blockchain demo

Week - 2: Working with Metamask wallet and block explorers

Installing Metamask, creating wallet and examining wallets in block explorers (etherscan, blockstream, coinmarketcap)

Week - 3: Practicing Solidity Programming

Installing Remix IDE, Writing and deploying basic solidity programs

Week - 4: Practicing Solidity Programming

Solidity programs on arrays, Strings, mappings and functions

Week - 5: Practicing Solidity Programming

Solidity programs on constructors, if-else, loops, error handling, try-catch

Week - 6: Neo Blockchain

Installing and setting up Neo Blockchain test network and performing Neo transactions

Week - 7: Ganache-CLI Ethereum blockchain

Installing Ganache-CLI in VSCode IDE, launching local Ethereum blockchain network and deploying a smart contract

Week - 8: Building and Deploying an E-Voting Application
Building a Decentralized Application by designing a front end user interface through html,css,node js and writing a smart contract for E-Voting to interact with backend Ganache-CLI / Truffle Tool

Week - 9: Building and Deploying a Banking Application
Building a Decentralized Application by designing a front end user interface through html,css,node js and writing a smart contract for Banking Operations to interact with backend Ganache-CLI / Truffle Tool

Week - 10: HardHat Blockchain Tool
Installing HardHat Tool and viewing blockchain Accounts in HardHat and deploying a smart contract

Week - 11: Hyperledger Fabric Explorer
Installing Hyperledger fabric explorer and setting up and launch a fabric network

Week - 12: Hyperledger Fabric Composer
Installing Hyperledger Fabric composer tool, launch fabric network and run an asset application

Suggested Tools: *OpenSSL, Metamask, Etherscan, Blockstream, CoinMarketCap, CoinGecko, Remix IDE, Ganache-CLI, HardHat*

Course Code	Course Title						Core/ Elective
U22PW781CB	Capstone Project Work- I						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Programming skills	-	-	-	2	50	-	1

Course Objectives

1. Enhance practical and professional skills.
2. Familiarize students with tools and techniques for software project implementation and documentation
3. Expose students to industry practices and teamwork.
4. Encourage students to work with innovative and entrepreneurial ideas.

Course Outcomes

Upon completion of the course, students will be able to:

1. Synthesize and apply the knowledge and skills acquired in the academic program to real-world problems.
2. Investigate and evaluate prominent literature relevant to their project.
3. Define the problem and identify the scope to meet the requirements using software design principles.
4. Demonstrate effective written and oral communication skills.
5. Demonstrate the ability to work as part of a team.

Aim of the Project Work

The aim of the project work is to develop solutions to realistic problems by applying the knowledge and skills obtained from different courses, new technologies, and current industry practices. This requires students to understand current problems in their domain and methodologies to solve these problems. To raise awareness about current problems and solution techniques, the first 3 weeks of the VII semester will be dedicated to special lectures by faculty members, research scholars, postgraduate students of the department, and invited lectures by engineers from industries and R&D institutions. After these seminars, each group must formalize the project proposal based on their own ideas or suggestions from the project guide.

Seminar schedules must be strictly adhered to by the students. At least two senior faculty along with the guide will evaluate students for the award of sessional marks based on performance in all the reviews.

Week Wise Activity schedule

It is the responsibility of faculty who guide student projects to mentor students towards completion of project by supporting them throughout the semester in performing the following activities:

Week	Activities
Week 1 - 3	● Identification of broad area and problem ● Finalization of project team and guide
Week 4 - 5	Review I: 10 marks : Abstract Approval Seminar ● Students must submit a synopsis consisting of problem definition, scope and objectives. Acceptance or rejection will be declared by the Project Review Committee (PRC). Students whose abstracts are rejected must resubmit with corrections suggested by the PRC.
Week 6 – 7	Review II: 20 marks: High level design Students must present Software Requirements Specification (SRS) and plan of work
Week 8 – 9	Survey of literature and existing solutions for the problem
Week 10 – 11	Review III: 20 marks: Survey Seminar Students must present details of literature survey including tools and technologies relevant to the project
Week 12 – 14	Document preparation and submission after verification by guide and project coordinator.

The department will appoint a project coordinator who will coordinate the following tasks:

- Collection of project topics/descriptions from faculty members (problems can also be invited from industries).
- Grouping of students (maximum of 3 in a group).
- Allotment of project guides.
- Dissemination of guidelines provided by the monitoring committee comprising senior faculty members to the students and their guides.
- Scheduling of project reviews.
- Consolidation of project review marks.

Course Code	Course Title						Core/ Elective
U22PW782CB	**Summer Internship**						Core
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
Programming Skills	-	-	-	-	50	-	1

Course Objectives:

1. Develop practical problem-solving skills in real-world contexts.
2. Integrate theoretical knowledge with practical application in real-life scenarios.
3. Cultivate confidence in communication with industry professionals.
4. Foster interaction with industry engineers to understand work culture and ethics.
5. Provide valuable exposure to industry practices and standards.

Course Outcomes:

On completion of this course, the student will be able to-

1. Proficient in designing and developing small-scale hardware or software products.
2. Capable of achieving predefined objectives within a limited scope, emphasizing task completion.
3. Skilled in identifying and evaluating alternative solutions for given problems.
4. Effective implementation of selected solutions with comprehensive documentation.
5. Enhanced problem-solving abilities through practical application in real-world scenarios.

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1. Summer internship is introduced as part of the curricula for encouraging students to work on problems of interest to industries.
2. A batch of two or three students will be attached to a person from an Industry / R & D Organization / National Laboratory for a period of 4 weeks.
3. This will be during the summer vacation following the completion of the **VI semester course.**
4. One faculty member will act as an internal guide for each batch to monitor the progress and interacts with the Industry guide.
5. After the completion of the Internship project, students will submit a brief technical report on the project executed and present the work through a seminar talk to be organized by the department.
6. Award of sessional marks are based on the performance of the student at the work place and awarded by industry guide and internal guide (25 Marks) followed by presentation before the committee constituted by the department (25 Marks).
7. One faculty member will coordinate the overall activity of Summer Internship.
8. Note: * Students have to undergo summer internship of **4 weeks duration at the end of semester VI and credits will be awarded after evaluation in VII semester.**

Note: * Students have to undergo summer internship of 4 weeks duration at the end of semester VI and credits will be awarded after evaluation in VII semester.

R21-BE CSE (IoT-CS-BcT) SEMESTER-VIII

S. No.	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	Pr/ Drg	Contact Hrs/ week	CIE	SEE	Duration of SEE (Hrs.)	
Theory Courses										
1	U22PE85XXX	Professional Elective – V	3	-	-	3	30	70	3	3
2	U21OE83XXX	Open Elective – III	3	-	-	3	30	70	3	3
Practical/ Laboratory Courses										
3	U22PW881CB	Capstone Project Work - II	-	-	**20**	20	50	150	3	10
		Total	**6**	**-**	**20**	**26**	**110**	**290**	**9**	**16**

Professional Elective – V		
S.No.	**Code**	**Course Title**
1	U22PE851AL	Quantum Computing
2	U22PE852DS	Information Retrieval Systems
3	U22PE853CB	Software Quality and Testing
4	U22PE854CB	Fog and Edge Computing
5	U22PE855AL	Bigdata Analytics

Open Elective -III		
S.No.	**Code**	**Course Title**
1	U21OE831AE	Motor Sport Engineering
2	U21OE831CE	Road Safety Engineering
3	U21OE831CS	Artificial Intelligence Techniques
4	U21OE831EC	Fundamentals of IOT
5	U21OE832EC	Principles of Computer Communication and Networks
6	U21OE831EE	Smart Building Systems
7	U21OE831IT	Principles of Information Security
8	U21OE831ME	Material Handling
9	U21OE832ME	Smart Materials and Sensors
10	U21OE831PH	Nano Science

Course code	Course Title						Core/ Elective
U22PE851AL	Quantum Computing						Elective
Prerequisite	Contact Hours per week				CIE	SEE	Credits
	L	T	D	P			
Engineering Mathematics	3	-	-	-	30	70	3

Course Objectives:

1. To introduce the fundamentals of quantum computing
2. To translate fluently between the major mathematical representations and its quantum operations.
3. To implement' basic quantum algorithms.
4. To explain quantum decoherence in systems for computation.
5. To discuss the physical basis of uniquely quantum phenomena.

Course Outcomes:

At the end of the course students will be able to

1. Describe the basics of quantum computing
2. Describe the physical implementation of Qubit
3. Explore building blocks and programming methodologies for quantum computing.
4. Identify the working of a Quantum Computing Program, its architecture and program model.
5. Explain the Impact of Quantum Computing on Cryptography

UNIT-I

Introduction to Essential Linear Algebra: Some Basic Algebra, Matrix Math, Vectors and Vector Spaces, Set Theory.

Complex Numbers: Definition of Complex Numbers, Algebra of Complex Numbers, Complex Numbers Graphically, Vector Representations of Complex Numbers, Pauli Matrice, Transcendental Numbers.

UNIT-II

Basic Physics for Quantum Computing: The Journey to Quantum, Quantum Physics Essentials, Basic Atomic Structure, Hilbert Spaces, Uncertainty, Quantum States, Entanglement.

Basic Quantum Theory: Further with Quantum Mechanics, Quantum Decoherence, Quantum Electrodynamics, Quantum Chromodynamics, Feynman Diagram Quantum Entanglement and QKD, Quantum Entanglement, Interpretation, QKE.

UNIT-III

Quantum Architecture: Further with Qubits, Quantum Gates, More with Gates, Quantum Circuits, The D-Wave Quantum Architecture.

Quantum Hardware: Qubits, How Many Qubits Are Needed? Addressing Decoherence, Topological Quantum Computing, Quantum Essentials.

UNIT-IV

Quantum Algorithms: What Is an Algorithm? Deutsch's Algorithm, Deutsch-Jozsa Algorithm, Bernstein-Vazirani Algorithm, Simon's Algorithm, Shor's Algorithm, Grover's Algorithm.

UNIT-V

Current Asymmetric Algorithms: RSA, Diffie-Hellman, Elliptic Curve.

The Impact of Quantum Computing on Cryptography: Asymmetric Cryptography, Specific Algorithms, Specific Applications.

Text Books:

1. *Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press*
2. *Dr. Chuck Easttom, Quantum Computing Fundamentals, Pearson*

Reference Books:

1. *Quantum Computing for Computer Scientists by Noson S. Yanofsky and Mirco A. Mannucci*
2. *Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. Basic Concepts. Vol. Basic Tools and Special Topics, World Scientific.*
3. *Pittenger A. O., An Introduction to Quantum Computing Algorithms.*

e-Resources*:*

Introduction to Quantum Computing: Quantum Algorithms and Qiskit, IBM and IITM
Prof. Prabha Mandayam, Prof. Anupama Ray, Prof. Sheshashayee Raghunathan -
https://nptel.ac.in/courses/106106232

Course Code	Course Title						Core / Elective
U22PE852DS	Information Retrieval Systems						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
PPSC, PSP, OOPJ, WT, DBMS,	3	-	-	-	30	70	3

Course Objectives

1. To provide the knowledge on information retrieval system capabilities.
2. To delve into the concepts of Cataloging and Indexing.
3. To explore into Automatic Indexing's diverse classes and Document/Term Clustering.
4. To educate learners about various user search techniques.
5. To discuss about information visualization and system evaluation.

Course Outcomes

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

1. Understand various functionalities and capabilities of Information Retrieval System.
2. Gain knowledge on cataloging and data structure methodology for IRS.
3. Differentiate various clustering algorithms and indexing.
4. Differentiate various user search techniques and system search techniques.
5. Understand the concepts of information visualization and text search.

UNIT-I

Introduction: Definition, Objectives, Functional Overview, Relationship to DBMS, Digital Libraries and Data Warehouses.

Information Retrieval System Capabilities: Search, Browse, Miscellaneous.

UNIT-II

Cataloging and Indexing: Objectives, Index Process, Automatic Indexing, Information Extraction.

Data Structures: Introduction, Stemming Algorithms, Inverted File Structure, N-Gram Data Structure, PAT Data Structure, Signature File Structure, Hypertext Data Structure.

UNIT-III

Automatic Indexing: Classes of Automatic Indexing, Statistical Indexing, Natural Language, Concept Indexing.

Document and Term Clustering: Introduction, Thesaurus Generation, Item Clustering, Hierarchy of clusters.

UNIT-IV

User Search Techniques: Search Statements and Binding, Similarity Measures and Ranking, Relevance Feedback, Selective Dissemination of Information Search, Weighted Searches of Boolean Systems, Searching the Internet and Hypertext.

UNIT-V

Information Visualization: Introduction, Cognition and Perception, Information Visualization Technologies.

Text Search Algorithms: Introduction, Software Text Search Algorithms, Hardware Text Search Systems.

Text Book:

1. *Kowalski, Gerald, Mark T May bury: INFORMATION STORAGE AND RETRIEVAL SYSTEMS: Theory and Implementation, Second Edition, Kluwer Academic Press.*

Reference Books:

1. *Gerald Kowalski: INFORMATION RETRIEVAL Architecture and Algorithms.*
2. *Frakes, W.B., Ricardo Baeza-Yates: Information Retrieval data Structures and Algorithms, Prentice Hall, 1992.*
3. *Modern Information Retrieval by Yates Pearson Education.*
4. *Information Storage & Retrieval by Robert Korfhage –John Wiley & Sons.*

e-Learning Resources:

1. *https://class.coursera.org/nlp/lecture/178*
2. *http://cosmolearning.org/courses/database-design-417/video-lectures/*
3. *http://nptel.ac.in/video.php?subjectId=106102064*

Course Code	Course Title						Core/ Elective
U22PE853CB	Software Quality and Testing						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
SE, Engg. Math.	3	-	-	-	30	70	3

Course Objectives:

1. To understand the basics of Software quality testing, test planning & design and test team organization.
2. To gain knowledge on software quality concepts, standards, measurements, and practices that support the production of quality software.
3. To learn techniques involved in test case design, test management and test measurement strategies, which improve the effectiveness of software test processes.
4. To study the various types of tests in the life cycle of the software product.
5. To identify various methods of software quality assurance, metrics and defect prevention techniques.

Course Outcomes:

After completion of this course students will be able to

1. Understand Software Testing terminology, various activities of Test Engineer and Test coverage criteria.
2. Identify defect prevention techniques and SQA metrics.
3. Understand system testing and significance of software reliability.
4. Evaluate the effectiveness of software quality processes for quantitative methods.
5. Test Object-Oriented and Web Application Software's and perform white-box and black-box tests in the life cycle of the software product.

UNIT-I

The Software Quality Challenge, Software Quality Assurance (SQA) -Definition and Objectives, Software Quality Factors, The Components of the Software Quality Assurance System – Overview, Development and Quality Plans.

UNIT-II

Integrating Quality Activities in the Project Life Cycle, Assuring the Quality of Software Maintenance Components, CASE Tools and their effect on Software Quality, Procedure and Work Instructions, Supporting Quality Devices, Configuration Management, Documentation Control, Project Progress Control.

UNIT-III

Software Quality Metrics, Costs of Software Quality, Quality Management Standards – ISO 9000 and Companion ISO Standards, CMM, CMMI, PCMM, Malcom Balridge, 3 Sigma, 6 Sigma, SQA Project Process Standards – IEEE Software Engineering Standards.

UNIT-IV

SoftwareTesting-Definition and objectives – Software Testing Strategies – Software Test Classifications - White Box Testing: Data Processing, Calculation Correctness Tests, Mccabe"s Cyclomatic Complexity

Metrics, Software Qualification and Reusability Testing, Advantages and Disadvantages of White Box Testing – Black Box Testing: Equivalence Classes for Output Correctness Tests, Revision Factor Testing Classes, Transition Factor Testing Classes, Advantages and Disadvantages of Black Box Testing – The Testing Process – Test Case Design – Automated Testing – Alpha and Beta Site Testing Programs.

UNIT-V

Software Testing Tools, Taxonomy of Testing Tools, Methodology to Evaluate Automated Testing Tools, Load Runner, Win Runner and Rational Testing Tools, Java Testing Tools, JMeter, JUnit and Cactus.

Text Books:

1. *Daniel Galin, Software Quality Assurance–From Theory to Implementation, Pearson Education.*
2. *K.V.K.K. Prasad, Software Testing Tool, Wiley Publishers.*

Reference Books:

1. *Mordechai Ben Menachem / Garry S. Marliss, Software Quality–Producing Practical, Consistent Software, BS Publications.*
2. *William E. Perry, Effective Methods for Software Testing, 2nd Edition, Wiley.*
   Srinivasan Desikan, Gopalaswamy Ramesh, Software Testing, Principles and Practices, Pearson Education.

e-Resources:

1. *Software Testing, IIT Kharagpur, Prof. Rajib Mall - https://nptel.ac.in/courses/106105150*
2. *Quality Assurance (QA) - Techniques and Methodologies, Alison - https://alison.com/course/quality-assurance-qa-techniques-and-methodologies*

Course Code	Course Title						Core / Elective
U22PE854CB	Fog and Edge Computing						Elective
	Contact Hours per Week						
Prerequisite	L	T	D	P	CIE	SEE	Credits
IoT-CP&A	3	-	-	-	30	70	3

Course Objectives

1. Understand the principles and applications of fog and edge computing in distributed systems.
2. Explore techniques for deploying and managing fog and edge computing infrastructure.
3. Analyze the role of fog and edge computing in enhancing real-time data processing and reducing latency.
4. Investigate security challenges and solutions associated with fog and edge computing environments.
5. Develop practical skills for designing and implementing fog and edge computing solutions for various IoT and edge devices.

Course Outcomes

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

1. Implement scalable, secure Fog computing solutions for IoT.
2. Justify designs of health monitoring systems with Fog computing, emphasizing smart e-health gateways.
3. Deploy SDN in Fog Computing for secure, efficient networking.
4. Understand Edge Computing's purpose and communication models.
5. Design IoT architectures and apply Edge computing solutions

UNIT-I

Fog computing requirements when applied to IoT: Scalability, Interoperability, FogIoT architectural model, Challenges on IoT Stack Model via TCP/IP Architecture, Data Management, filtering, Event Management, Device Management, cloudification, virtualization, security and privacy issues. Integrating IoT, Fog, Cloud Infrastructures: Methodology , Integrated C2F2T Literature by Modelling Technique re by Use-Case Scenarios , Integrated C2F2T Literature by Metrics

UNIT-II

Exploiting Fog Computing in Health Monitoring : An Architecture of a Health Monitoring IoTBased System with Fog Computing , Fog Computing Services in Smart E-Health Gateways, Discussion of Connected Components. Fog Computing Model for Evolving Smart Transportation Applications: Introduction , Data-Driven Intelligent Transportation Systems , Fog Computing for Smart Transportation Applications Case Study: Intelligent Traffic Lights Management (ITLM) System

UNIT-III

Software Defined Networking and application in Fog Computing: Open Flow Protocol, Open Flow Switch, SDN in Fog Computing, Home Network using SDN. Security and Privacy issues: Trust and privacy issues in IoT Network, web Semantics and trust Management for Fog Computing, Machine Learning based security in Fog Computing, Cyber- Physical Energy Systems over Fog Computing

UNIT-IV

Introduction to Edge Computing Scenarios and Use cases - Edge computing purpose and definition, Edge computing use cases, Edge computing hardware architectures, Edge platforms, Edge vs Fog Computing, Communication Models - Edge, Fog, and M2M.

UNIT-V:

IoT Architecture and Core IoT Modules-A connected ecosystem,IoT versus machine-to-machine versus, SCADA, The value of a network and Metcalfe's and Beckstrom's laws, IoT and edge architecture, Role of an architect, Understanding Implementations with the examples- Edge computing with RaspberryPi, Industrial, and Commercial IoT and Edge, and Edge computing and solutions.

Text Books

1. *Fog Computing: Theory and Practice by Assad Abbas, Samee U. Khan, Albert Y. Zomaya*
2. *IoT and Edge Computing for Architects - Second Edition, by Perry Lea, Publisher: Packt Publishing, 2020, ISBN: 9781839214806*

Reference Books

1. *Raspberry Pi Cookbook, 3rd Edition, by Simon Monk, Publisher: O'Reilly Media, Inc., 2019, ISBN: 978149204322*
2. *Fog and Edge Computing: Principles and Paradigms (Wiley Series on Parallel and Distributed Computing) by Rajkumar Buyya and Satish Narayana Srirama*
3. *Flavio Bonomi, Rodolfo Milito, Jiang Zhu, Sateesh Addepalli, —Fog Computing and Its Role in the Internet of Things, MCC'12, August 17, 2012, Helsinki, Finland*

e-Resources:

1. *Edge Computing, IIT Kanpur - https://nptel.ac.in/courses/106104449*
2. *Cloud, edge and fog computing for IoT - https://www.youtube.com/watch?v=NR36RcNtvRs - https://www.youtube.com/watch?v=x13NRw4uMuI*

Course Code	Course Title						Core/ Elective
U22PE855AL	BigData Analytics						Elective
	Contact Hours per week						
Prerequisite	L	T	D	P	CIE	SEE	Credits
Engg. Math., Machine Learning	3	-	-	-	30	70	3

Course Objectives:

1. Understand distributed/parallel algorithm design to process massive datasets
2. Demonstrate proficiency with analysis of unstructured big data using tools.
3. Develop the ability to build and assess data-based models. distributed software architectures and how they allow programmers to reason about computations at a massive scale
4. Understand overview of some of the important and next generation systems like Spark, Storm, Giraph and Hive etc
5. Apply large dataset architecture concepts and methods to solve problems in real-world contexts and will communicate these solutions effectively

Course Outcomes:

At the end of the course, a student will be able to

1. Understand the pros and cons of the traditional relational databases and need for distributed architecture for data processing of large datasets. (L2)
2. Implementation and analysis of unstructured data using Big Data Tools (L4)
3. Implement map reduce programs to solve data analysis tasks. (L4)
4. Understand and explain distributed software architectures, runtime and storage strategies used by Apache Hadoop. (L3)
5. Explain the need and use cases for emerging architectures such as Spark, Storm (L3)

UNIT-I

What is Big Data and Why is It Important, Hadoop, HDFS and MapReduce architecture, structured and unstructured data, Big Data and Advances in Health Care

UNIT-II

Nosql data management and MongoDB, Types of Nosql databases, benefits of Nosql, Mongodb: Characteristics, APIs, restful APIs, Mongodb Installation, Sharding, Hbase: Introduction, Features, Data Models, Jason based query Language, Components, Data types, Operators, Functions

UNIT-III

MapReduce: Map Operations, Reduce Operations, shuffle, sort, Mapreduce features, Mapreduce types and formats, Mapreduce failures

UNIT-IV

Apache HDFS: Architecture, File Operations, Hadoop compression, serialization, Hadoop Configuration

UNIT-V

Hive: Introduction, Data Models, File formats, Hiveql, Spark.

Text Books

1. *Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley,2013.*
2. *V.K. Jain, Big Data and Hadoop, Khanna Book Publishing Company 2020.*
3. *V.K. Jain, Data Science and Analytics (with Python, R and SPSS Programming), Khanna Book Publishing Company.*
4. *P. J. Sadalage, M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.*
5. *Tom White, "Hadoop: The Definitive Guide", 3/e, O'Reilly, 2012.*

Reference Books

1. *Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 2 edition (30 September 2014)*

e-Resources:

Big Data Computing, IIT Patna, Dr. Rajiv Misra - https://archive.nptel.ac.in/courses/106/104/106104189/

Open Elective -III

Course Code	Course Title						Core/ Elective
U21OE831 AE	Motor Sport Engineering						Open Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

It is intended to make the students to

1. Understand the types of engines in the vehicles.
2. Understand the Working of Fuel, Ignition system.
3. Understand the Working of Lubrication and cooling system.
4. Understand the Working of transmission system.
5. Understand the Working of Suspension and Steering system.

Course Outcomes:

After the completion of this unit, the student is able to

1. Generalize the different types of automobiles and engine components.
2. Differentiate the ignition and injection system.
3. Describe and differentiate the lubrication and cooling system.
4. To identify different components and working of transmission system.
5. To identify different components and suspension and steering system.

UNIT-I

Power unit: Types of engines, engine performance, engine construction, two stroke and four stroke engines and materials.

UNIT-II

Ignition and Fuels: Introduction to ignition system, Battery, Magneto and electronic ignition system. Introduction to injection system, types of fuel system, carburetor, injector, Super charging and turbocharging.

UNIT-III

Lubrication and Cooling: Requirements of lubrications system, classification of lubrications system and types of oil used for lubrications, Requirements of cooling system, types of oil pumps and filters, liquid cooling, forced cooling system, function of thermostat, radiator, fan and coolant.

UNIT-IV

Transmission: Classification of clutch, single plate clutch, multi plate clutch, centrifugal clutch, operating mechanism of clutch, rod, cable, hydraulic clutch, clutch adjustment, Gear box types, constant mesh gearbox, synchromesh gear box and gear ratio calculations, Propeller shaft, final drive and differential.

UNIT-V

Suspension and Steering: Requirements of suspension system, Independent and dependent type suspension system, working principle of shock absorber, Introduction to steering system, types of steering system, steering geometry, caster, camber, toe-in, toe-out, king pin inclination rack and pinion steering system.

Suggested Reading:

1. *Practical motorsport engineering by Andrew Liversey.*
2. *Crouse &Anglin, 'Automotive Mechanics' Tata McGraw Hill, Publishing Co., Ltd., NewDelhi, Tenth edition - 2004.*
3. *Kirpal Singh, "Automobile Engineering", Vol I & II Standard Publishers, Delhi.*
4. *Joseph Heitner, 'Automotive Mechanics', Affiliated East West Pvt., Ltd.,* Road Safety Engineering

Course Code	Course Title						Core / Elective
U21OE831CE	Road Safety Engineering						Open Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
--	3	-	-	-	30	70	3

Course Objectives: The objectives of this course is to impart knowledge on

1. Various factors considered for road safety and management.
2. Road safety appurtenances and design elements.
3. Various traffic management techniques for safety

Course Outcomes: After completing this course, the students will be able to

1. Understand Road Safety scenario and basic concepts of road accident statistics
2. Analyze road accidents to determine possible causes from accident investigation reports
3. Apply design principles for roadway geometrics improvement with various types of traffic safety appurtenances/tools.
4. Understand design concepts and provisions of traffic signals and road signs and Safety at Construction Site
5. Understand Traffic Management Systems for Safety and road safety audit process

UNIT – I

Introduction: Road Safety scenario in India and World, Road Accident Characteristics.

Traffic Safety Analysis: Fundamentals of Traffic Engineering - Basic Characteristics of Motor- Vehicle Traffic, Highway Capacity, Applications of Traffic Control Devices, Parking Facilities, Traffic Engineering Studies; Basic concepts of Road accident statistics, Statistical Methods in Traffic Safety Analysis – Safety performance function

UNIT – II

Accident Analysis: Accident Investigations and Risk Management, Collection and Analysis of Accident Data, Condition and Collision Diagram, Causes and Remedies, Traffic Management Measures and Their Influence on Accident Prevention, Assessment of Road Safety, Methods to Identify and Prioritize Hazardous Locations and Elements, Determine Possible Causes of Crashes, Crash Reduction Capabilities and Counter measures, Effectiveness of Safety Design Features, Accident Reconstruction. Application of computer analysis of accident data.

UNIT – III

Traffic Safety in Vehicles and Road Geometrics: Vehicle And Human Characteristics, Road Design factors for safety, Junctions and Cross Section Improvements, Road Maintenance, Traffic Control, Protective Devices in Vehicles, Post Accident Care.

UNIT – IV

Traffic Signals & Road signs: Traffic Signals, Factors affecting signal design, street lighting, Provisions for NMT Vehicles in India, Safety Provisions for Pedestrians & Cyclists, Road Delineators, Road Signs and Pavement Markings.

Safety at Construction Site: Safety provisions for workers at construction site, Construction Zone markings, signs.

UNIT – V

Traffic Management safety audit: Traffic Management Systems for Safety, Road Safety Audits and Tools for Safety Management Systems, Road Safety Audit Process, Approach to Safety, Road Safety Improvement Strategies, ITS and Safety.

Text Books:

1. L.R. Kadiyali and N.B.Lal. "Principles and Practice of Highway Engineering", 2003
2. Roger P. Roess, Elena S. Prassas, William R. Mcshane, "Traffic Engineering", 2004
3. Myer Kutz, ―"Hand Book of Transportation Engineering", Editor McGraw Hill, 2004
4. Khanna,.S.K., Justo C.E.G., Veeraraghavan. A., "Highway Engineering", 10thEdition, Nem Chand & Bros, 2015

Reference Books:

1. Training Course for Road Safety Course Material Ministry Of Road Transport And Highways Government Of India-Organized by Asian Institute of Transport Development, New Delhi
2. IRC:SP:88-2010 Manual on Road Safety Audit Published By Indian Roads Congress (Irc)
3. FHWA Proven Safety Countermeasures http://safety.fhwa.dot.gov
4. Road Delineators, IRC:79
5 .Road Signs, IRC:67
6 .Specification for Road Traffic Signals, IS: 7537-1974
7. Guidelines on Design and Installation of Road Traffic Signals, IRC: 93.

Course Code	Course Title						Core/ Elective
U21OE831CS	Artificial Intelligence Techniques						Open Elective
Prerequisite	Contact Hours per week				CIE	SEE	
	L	T	D	P			
----	3		-	-	30	70	3

Course Objectives

1. Understand the importance of the field of AI by discussing its history and various applications.
2. Learn about one of the basic applications of A.I, search state formulations.
3. Learn methods of expressing knowledge by a machine with appropriate reasoning and different mathematics involved behind it
4. Learn how to reason when an agent has only uncertain information about its task.
5. Know basics of fuzzy logic and processes of physical agents

Course Outcomes

After completing this course, the student will be able to:

1. Formalize a problem in the language/framework of different AI methods.
2. Illustrate basic principles of AI in solutions that require problem solving, search, inference.
3. Represent natural language/English using Predicate Logic to build knowledge through various representation mechanisms.
4. Demonstrate understanding of steps involved in building of intelligent agents, expert systems, Bayesian networks.
5. Demonstrate understanding of steps involved in perception and action of agents

UNIT-I

Introduction - What is intelligence? Foundations of artificial intelligence (AI). History of AI, Structure of Agents.

Problem Solving - Formulating problems, problem types, states and operators, state space.

Uninformed Search Strategies - Breadth-first search, Depth-first search, Iterative deepening Depth-first search

Problems – tic-tac-toe, 8-puzzle problem, Water Jug Problem, Missionaries and cannibals' problem, Monkey and banana problem.

UNIT-II

Search strategies. - Informed Search Strategies- Greedy Best first search, A* algorithm, heuristic functions

Adversarial Search/ Game playing – Perfect/ imperfect decision game, Mini-max search, alpha- beta pruning

UNIT-III

Propositional Logic - Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic,

Propositional Theorem Proving: Inference and proofs, Proof by Resolution

First-Order Logic - Representation, Syntax and Semantics of First-Order Logic, Inference using resolution

UNIT-IV

Expert System and Applications: Introduction, Phases in Building Expert Systems, Expert System Architecture. (Book 2)

Uncertainty: Probability Theory, Bayesian Belief Networks (Book 2)

UNIT-V

Fuzzy Logic Systems: Crisp and Fuzzy Sets, Terminology, Fuzzy Inference Control (Book 3)

Perception & Action: Real time Search, Perception, Action (Book 3).

Text Book:

1. *Stuart Russell and Peter Norvig. Artificial Intelligence – A Modern Approach, Third edition, Pearson Education Press.*
2. *Saroj Kaushik, Artificial Intelligence, Cengage Learning, 2011*
3. *Kevin Knight, Elaine Rich, B. Nair, Artificial Intelligence, McGraw Hill, 3rd ed, 2009.*

Reference Books:

1. *Nils J. Nilsson, The Quest for Artificial Intelligence, Cambridge University Press, 2009*
2. *Artificial Intelligence, 3rd Edn., Patrick Henny Winston, 3rd Edn., Pearson Education.*
3. *A First Course in Artificial Intelligence, Deepak Khemani, Tata Mc-Grah Hill*

Course Code	Course Title						Core / Elective
U21OE831EC	Fundamentals of IOT						Open Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives

1. Discuss fundamentals of IoT and its applications and requisite infrastructure.
2. Describe Internet principles and communication technologies relevant to IoT.
3. Discuss hardware and software aspects of designing an IoT system.
4. Describe concepts of cloud computing and Data Analytics.
5. Discuss business models and manufacturing strategies of IoT products.

Course Outcomes

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

1. Understand the various applications of IoT and other enabling technologies.
2. Comprehend various protocols and communication technologies used in IoT
3. Design simple IoT systems with requisite hardware and C programming software
4. Understand the relevance of cloud computing and data analytics to IoT
5. Comprehend the business model of IoT from developing a prototype to launching a product

UNIT-I

Introduction to Internet of Things: Definition and Characteristics of IoT. Physical Design of IoT: Things in IoT. Logical Design of IoT: IoT functional Blocks, Communication Models, APIs. Introduction of IoT enabling Technologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics, IoT and M2M.

UNIT-II

IoT Platforms: What is an IoT Device, Exemplary Devices: Raspberry Pi, Raspberry Pi Interfaces, Arduino, ESP 8266.
Connectivity platforms and Protocols: RFID, LoRa, HTTP, MQTT, CoAP protocols.

UNIT-III

Developing Internet of Things: IoT design Methodology, Case study on IoT System for weather monitoring.
IoT Applications: Smart Home, Smart Cities, Smart Energy, Smart Retail and Logistics, Smart Agriculture Smart Industry and Smart Health.

UNIT-IV

Cloud computing and IoT Product Manufacturing: Introduction to cloud storage models, Amazon Web Services for IoT, ThingSpeak cloud services. Business model for IoT product manufacturing, IoT Start-ups, Ethical issues in IoT.

UNIT-V

Industry 4.0: Introduction to the Industrial Internet, Industrial IoT (IIoT) reference architecture, Designing Industrial Internet systems, Use Cases.

Textbooks :

1. *Vijay Madisetti, ArshdeepBahga "Internet of Things (A Hands-On-Approach)", VPT Publisher.*
2. *Hakim Cassimally, Adrian McEwen (Author), "Designing the Internet of Things", Wiley India Publishers.*

References :

1. *Internet of Things - Converging Technologies for smart environments and Integrated ecosystems, River Publishers.*
2. *Alasdair Gilchrist, "Industry 4.0 The Industrial Internet of Things", Apress.*

Course Code	Course Title						Core/ Elective
U21OE832EC	Principles of Computer Communication and Networks						Open Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	30	70	3

Course Objectives:

1. To discuss the concept of computer communication.
2. To illustrate about the networking concept, layered protocols in the OSI model.
3. To describe the representation of analog and digital signals.
4. To analyze the types of communication medium and its access methods.
5. To comprehend various networking equipment.

Course Outcomes

After completing this course, the student will be able to:

1. Understand the basic concepts of computer networking and data transmission between computers.
2. Understand the various communication concepts and the layers in the OSI model.
3. Analyze the representation of analog and digital signals and the bandwidth requirements.
4. Relate the types of communication medium and its access methods.
5. Analyze the structure and equipment for computer network structures.

UNIT-I

Overview of Computer Communications and Networking: Introduction to Computer Communications and Networking, Types of Computer Networks, Network Addressing, Routing, Reliability, Interoperability and Security, Network Standards, the Telephone System and Data Communications.

UNIT-II

Essential Terms and Concepts : Computer Applications and application protocols Computer Communications and Networking models, Communication Service Methods and data transmission modes, Analog and Digital Communications, Speed and Capacity of a Communication Channel, Multiplexing and Switching, Network architecture and the OSI reference model.

UNIT-III

Physical and data link layer Concepts: The Physical and Electrical Characteristics of wire Copper media, fiber optic media, Wireless Communications, Introduction to data link Layer, the logical link control and medium access control sub-layers.

UNIT-IV

Data Communication and Networking: Ethernet, Network Layer – Internet Protocol (IPv4/IPv6), Transport Layer – TCP, UDP. Wireless Technologies: Wireless LAN, Bluetooth and ZigBee.

UNIT-V

Network Hardware Components: Introduction to Connectors, Transceivers and media convertors, repeaters, Network Interface Cards and PC Cards, Bridges, Switches, Switches VS Routers.

Text Books:

1. *Michel A. Gallo and William H, Hancook, "Computer Communications and Networking Technologies", , Thomson Brooks/ Cole.*
2. *Behrouz A, Forouzan, "Data Communication and Networking", Fourth Edition MC GRAW HILL EDUCATION, 2006.*

Reference Books :

1. *M. Barry Dumas, "Principles of Computer Networks and Communications", Morris Schwatz, Pearson.*
2. *James F. Kurose, K. W. Ross, "Computer Networking : A Top-Down Approach Featuring the Internet", , 3rd Edition, Pearson Education.*

Course Code	Course Title						Core/Elective
U210E831 EE	Smart Building Systems						Open Elective
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			
----	3	-	-	-	30	70	3

Course Objectives

1. To design various sub systems of building automation
2. To integrate all the sub systems
3. To understand the basic blocks of Building Management System.

Course Outcomes

At the end of the course students will be able to

1. Understand and analyze current philosophy, technology, terminology, and practices used in building automation
2. Interpret different safety and security standards for building management System
3. Investigate various hardware and software requirement for given HVAC System
4. Evaluate energy management and communication for efficient Building Management System
5. Identify various tools and techniques in BMS for Design of Secure, Safe and Smart building

UNIT-I

Introduction: Concept and application of Building Management System (BMS) and Automation, requirements and design considerations and its effect on functional efficiency of building automation system, architecture and components of BMS.

UNIT-II

Fire Alarm (FA) System: concept of fire, Fire modes, History, Components, and Principles of Operation. Different fire sensors, smoke detectors and their types, Fire control panels, design considerations for the FA system. Field Components, Panel Components, Applications. Types of FAS, Architectures, Examples. Classification of FAS loops, Examples. FAS Design procedure in brief, NFPA 72A, BS 5839, IS, Concept of IP enabled fire & alarm system, design aspects and components of PA system.

UNIT-III

Access Control System: Access Components, Access control system Design.
CCTV: Camera Operation & types, Camera Selection Criteria, Camera Applications, DVR Based system, DVM, Network design, Storage design. Components of CCTV system like cameras, types of lenses, typical types of cables, controlling system. CCTV Applications.

UNIT-IV

Security Systems Fundamentals: Introduction to Security Systems, Concepts.
Perimeter Intrusion: Concept, Components, Technology, Advanced Applications. Security system design for verticals. Concept of automation in access control system for safety, Physical security system with components, RFID enabled access control with components, Computer system access control – DAC,

MAC, RBAC.
EPBX System & BMS subsystem integration: Design consideration of EPBX system and its components, integration of all the above systems to design BMS.

UNIT-V

Energy Management: Energy Savings concept & methods, Lighting control, Building Efficiency improvement, Green Building (LEED) Concept & Examples.
Building Management System: IBMS (HVAC, Fire & Security) project cycle, Project steps BMS, Advantages & Applications of BMS, IBMS Architecture, Normal & Emergency operation, Advantages of BMS.

Text Books:

1. *Jim Sinopoli, Smart Buildings, Butterworth-Heinemann imprint of Elsevier,2nd ed., 2010.*
2. *Reinhold A. Carlson, Robert A. Di Giandomenico, Understanding Building Automation Systems (Direct Digital Control,Energy Management, Life Safety, Security, Access Control, Lighting, Building Management Programs), R.S.Means Company Publishing, 1991.*
3. *Albert Ting-Pat So,WaiLok Chan,Kluwer, Intelligent Building Systems, Academic publisher,3rd ed.,2012.*

Reference Books:

1. *Robert Gagnon, Design of Special Hazards and Fire Alarm Systems, Thomson Delmar Learning; 2nd edition, 2007.*
2. *Levenhagen, John I. Spethmann, Donald H, HVAC Controls and Systems, McGraw-Hill Pub.*
3. *Hordeski, Michael F, HVAC Control in the New Millennium, Fairmont press, 2001.*
4. *Bela G. Liptak, Process Control-Instrument Engineers Handbook, Chilton book co.*

Course Code	Course Title						Core/ Elective
U21OE831 IT	**Principles of Information Security**						**Open Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			
-	**3**	**-**	**-**	**-**	30	70	**3**

Course Objectives

The student will be able

1. To provide basic concepts of Information security and threats its associated attacks.
2. To deal with legal, ethical, professional issues and the role of risk management.
3. To impart knowledge about Information security planning and technology.
4. To facilitate learning of cryptographic algorithms..
5. To acquaint with physical access and oversight of environmental controls and how security policy affects the ongoing technical and administrative evaluation..

Course Outcomes

After completing this course, the student will be able to

1. Define key terms of information security and outline the phases of Sec SDLC, business need for information security and identify various threats and attacks.
2. Distinguish between laws and ethics of information security and define risk management and explain how risk is identified and assessed..
3. Identify the major components of information security blue print and explain the Technologies that enable the use of firewalls and virtual private networks.
4. List the types of intrusion detection and prevention systems and explain the principles of Cryptography.
5. Adapt security Management models for information security maintenance.

UNIT-I

Introduction: History, critical characteristics of information, NSTISSC security model, Components of an information system, securing the components, balancing security and access, The SDLC, The security SDLC

Need for Security: Business needs, Threats, Attacks

UNIT-II

Legal, Ethical and Professional Issues: Law and ethics in information security, relevant U.S laws-international laws and legal bodies, Ethics and information security

Risk Management: Overview, Risk Identification, and risk assessment, Risk Control strategies, selecting a risk control strategy, Quantitative versus qualitative risk control practices

UNIT-III

Planning for Security: Security policy, Standards and practices, Security blue print, Security education, Continuity strategies.

Security Technology: Firewalls and VPNs: Physical design, firewalls, protecting remote connections.

UNIT-IV

Security Technology: Intrusion detection, Access control and other security tools: Intrusion detection and prevention systems, Scanning and analysis tools, Access control devices.

Overview of Cryptography: Foundations of cryptology, cipher methods, cryptographic Algorithms, Cryptographic tools, Protocols for secure communications, Attacks on cryptosystems

UNIT-V

Implementing Information Security: information security project management, technical topics of implementation, Non- technical aspects of implementation, Security certification and accreditation Information security Maintenance: Security management models. The maintenance model, Digital forensics.

Text books:

1. *Michael E. Whitman, Hebert J Mattord, "Principles of Information Security", 5th Edition, Cengage Learning, 2014.*
2. *William Stallings "Cryptography and Network Security Principles and Practice", 6th Edition, Pearson, 2014.*

Reference Books:

1. *Dr.V.K.Jain,"Cryptography and Network Security", 1st Edition, Khanna Book publishing, 2013..*
2. *Thomas R Peltier, JustingPeltier, JohnBlackley, "Information Security Fundamentals", Auerbacj Publications, 2010.*

Course Code	Course Title						Core / Elective
U21OE831ME	Material Handling						Open Elective
Prerequisite	Contact Hours/ Week				CIE	SEE	
	L	T	P	D			
Principles of Mechanical Engineering	3	-	-	-	30	70	3

Course Objectives

The objectives of this course are to get exposure to different material handling equipment like conveyors, hand trucks, cranes, monorails, hoists and their applications in engineering applications.

Course Outcomes

Upon completion of course, students will be able to

1. Classify the material handling equipment.
2. Explain the usage of different material handling equipment in industry.
3. Discuss how to connect loading stations to the different discharge conditions.
4. Associate the usage of cranes at industries.
5. Extend the knowledge for working on special material handling equipment.

UNIT-I

Introduction to Material Handling: Examples of materials equipment, classification of materials handling equipment, continuous conveying, intermittent conveying, examples, lifting, hoisting, handling of bulk goods and piece goods, cranes and conveyors, principles of calculation of conveying equipment, cycle time, cycle time, bulk materials and bulk density, angle of repose, example for a belt conveyor and simple hoist.

UNIT-II

Conveyors: Belt conveyor, constructional details, toughing angle, idlers, belt specifications, chutes, skirt boards, ploughs, belt conveyor layouts, belt trippers, and typical examples, roller conveyors, overhead conveyors, apron conveyors, component parts and operational details and applications with typical layouts.

UNIT-III

Unit Materials Handling and Storage: Unit load concept (platform sheet industrial hand trucks, self, contained unit load, pallet less handling, introduction only), industrial hand trucks, powered industrial trucks, automated guided vehicles, basic storage and equipment system, Automated storage and retrieval systems (AS/RS), Carosel storage system and its applications.

UNIT-IV

Cranes, Hoists and Monorails: Jib cranes, like wall mounted and travelling type, stability criteria, wheel loads, wheel trucks and bogeys, number of mechanisms in jib cranes, jib construction. Harbour cranes, luffing and level luffing cranes, shipyard gantry cranes, portal frames and slewing rings and bearings typical stability calculations of portal cranes, types of hoists.

UNIT-V

Special Materials Handling Equipment: Wagon tipplers, stackers, reclaimers, their constructional details,

pneumatic conveyers, typical materials handling layouts and applications.

***Text Books**:*

1. *Automation, Production Systems and Computer Integrated Manufacturing, Mikell P. Groover, Prentice Hall of India, 2001.*
2. *Introduction to Materials Handling, Siddhartha Ray, New Age International Publishers, Second Edition, 2017.*

Reference Books:

1. *Bulk Material Handling by Conveyor Belt, M.S.Alspaugh and R.O. Bailey, Society for Mining, Metallurgy and Exploration, 1996.*
2. *Materials Handling Principles and Practice, Allegri T.H, CBS Publishers, Bengaluru, 2004.*
3. *Material Handling Handbook, Raymond A Kulweick, ASME & IMMS, John Wiley & Sons, 1991.*

Course Code	Course Title						Core / Elective
U21OE832ME	Smart Materials and Sensors						Open Elective
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	P	D			
Applied Physics	3	-	-	-	30	70	3

Course Objectives

The objectives of this course are to

1. Study different smart materials used in various applications
2. Study various types of smart materials used in engineering applications
3. Study smart materials processing techniques
4. Study various sensors and its application in engineering.
5. Study various Actuators and its application in engineering.

Course Outcomes

Upon completion of course, students will be able to

1. Classify the various types of smart materials.
2. Understand types of smart materials in engineering application
3. Discuss various techniques of smart materials.
4. Extend the knowledge of use of smart materials as sensors
5. Know the knowledge of use of smart materials as actuators

UNIT-I

Overview of Smart Materials, classification of smart materials, components, advantages, disadvantages and application of smart materials

UNIT-II

Piezoelectric Materials, Elecrostrictive Materials, Magnetostrictive Materials, Magneto electric Materials. Magneto rheological Fluids, Electro Rheological Fluids, Shape Memory Materials.

UNIT-III

Semi-Conductors and their processing, metals and metallization techniques, ceramics and their processing, polymers and their synthesis, UV radiation curing of polymers.

UNIT-IV

Introduction, conductometric sensors, capacitive sensors, piezoelectric sensors, magneto stricitive sensors, Piezo resistive sensors, optical sensors, resonant sensors, semi-conductor based sensors, acoustic sensors, polymerize sensors, carbon nano tube sensors

UNIT-V

Introduction, electro static transducers, electromagnetic transducers, electro dynamic transducers, piezoelectric transducers, electro-strictive transducers, magneto-strictive transducers, electro thermal actuators, comparision of actuation, Applications. Cranes, hoists and monorails.

Text Books:

1. *Smart Material Systems and MEMS Design and Development Methodologies, V.K.Varadan,*
2. *K.J Vinoy, S.Gopala Krishnan, John Wiley and Sons, England, 2006.*
3. *Dynamics and Control of Structures, Leonard Meirovitch, John Wiley& Sons, 1990.*
4. *Smart Structures and Materials. Brian Culshaw, Artech House Publishers, Boston, 2004.*
5. *Piezoelectric Sensorics, G. Gautschi, Springer, 2002.*

Reference Books:

1. *Smart Materials and Structures, M. V. Gandhi and Thompson B.S, Chapman & Hall, London; New York, 1992*
2. *Smart Structures, Paulo Gaudenzi, Wiley , 1st Edition, 2009*
3. *Smart Structures- Analysis and Design, A.V. Srinivasan, D. Michael McFarland, Cambridge University Press, 2000.*
4. *Piezoelectric Actuators and Ultrasonic Motors, Kenji Uchino, Springer, New York, First Edition, 2011.*

Course Code	CourseTitle						Core/Elective
U21OE831PH	Nano Science						Open Elective
Prerequisite	Contact Hours per Week				CIE	SEE	
	L	T	D	P			
	3	-	-	-	30	70	3

course objectives:

1. To introduce Nanomaterials and its classification.
2. To explain the size dependent properties of Nanomaterials.
3. To describe the synthesis of Nanomaterials.
4. To summarize characterization techniques of nanomaterials.
5. To list out the applications of nanomaterials.

course outcomes:

1. Introduce Nanomaterials and its classification.
2. Explain the size dependent properties of nanomaterials.
3. Describe synthesis of nanomaterials.
4. Summarize the characterization techniques of nanomaterials.
5. List out the applications of nanomaterials.

UNIT-I

INTRODUCTION AND FUNDAMENTALS OF NANOMATERIALS:
Definitions, Classification of Nanomaterials- Zero Dimensional, 1-D, 2-D, 3-D, Nanoparticles, nanowires, nanoclusters, quantum well.
Fundamentals- Structure and bonding in Nanomaterials. Chemical Bonds (types and strength),Intermolecular Forces, Molecular and Crystalline Structures, Hierarchical Structures.

UNIT-II

PROPERTIES AND SIZE: Size dependent properties, Electronic, dielectric, magnetic, ChemicalOptical, thermal, Electrical, Mechanical.

UNIT-III

NANOMATERIAL SYNTHESIS: Synthesis of Nanomaterials: Top-down approach- Ball milling lithography, Bottom-up approach- PVD, CVD, Sol-gel, RF, Plasma, Sputtering, Laser ablation method, hydrothermal synthesis

UNIT-IV

NANOMATERIAL CHARACTERIZATION TECHNIQUES: Scanning and Transmission Electron Microscopy (SEM & TEM) Atomic Force Microscopy (AFM), Scanning Tunneling Microscopy (STM), Diffraction and scattering techniques Vibrational spectroscopy Surface techniques, dynamic light scattering

UNIT-V

APPLICATIONS: Applications-Nano electronics, Nano optics, chemical and bio- sensing, Biological/ bio-medical applications, Photovoltaic, fuel cells, batteries applications, High strengthnanocomposites, Nano energetic materials.ooks:

1. *The Physics and Chemistry of NanoSolids by Frank J. Owens and Charles P. Poole Jr, Wiley-Interscience, 2008.*
2. *Nanomaterials- Synthesis, Properties and Applications, Edited by A.S. Edelstein and R.C. Cammarata, Institute of Physics Publishing, London, 1998 (paper back edition).*
3. *Nanochemistry: A Chemical Approach to Nanomaterials, by G. Ozin and A. Arsenault, RSC Publishing, 2005.*
4. *Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience, Edward L. Wolf, Wiley-VCH, 2nd Reprint (2005).*
5. *The Science and Engineering of Microelectronic Fabrication, Stephen A. Campbell, second edition.*

Course Code	Course Title						Core/Elective
U22PW881CB	Capstone Project Work- II						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	20	50	150	10

Course Objectives

1. Enhance practical and professional skills.
2. Familiarize students with tools and techniques for systematic literature survey and documentation.
3. Expose students to industry practices and teamwork.
4. Encourage students to work with innovative and entrepreneurial ideas.

Course Outcomes

Upon completion of the course, students will be able to:

1. Synthesize and apply the knowledge and skills acquired in the academic program to real-world problems.
2. Design and analyze the project with respect to the problem's requirements.
3. Implement all the aspects of SDLC through the project work.
4. Demonstrate effective written and oral communication skills.
5. Demonstrate the ability to work as part of a team.

Aim of the Project Work

The aim of the project work is to develop solutions to realistic problems by applying the knowledge and skills obtained from different courses, new technologies, and current industry practices. This requires students to understand current problems in their domain and methodologies to solve these problems. After the seminars which were conducted in VII semester, each project group must be ready to design and develop the project proposal finalized in the previous semester. Seminar schedules must be strictly adhered to by the students. At least two senior faculty along with the guide will evaluate students for the award of sessional marks based on performance in all the reviews.

Week Wise Activity schedule

It is the responsibility of faculty who guide student projects to mentor students towards completion of project by supporting them throughout the semester in performing the following activities:

Week	Activities
Week 1 - 2	● Low level Design: Identify modules of project ● Acquaintance with the technologies needed for implementation
Week 3 - 4	● Review IV: 10 marks: A detailed description of the design phase to be presented.
Week 5 – 7	● Carry out implementation and ensure it meets the scope defined in the abstract.

	● Test for all the valid test cases
Week 8 – 9	Review V: 15 marks: Project demonstration that includes implementation details, results, test cases and deployment
Week 10 – 12	Incorporate the suggestions given in Review V Project Thesis preparation, presentation and submission of the draft
Week 13 – 14	Review VI: 10 marks: The final presentation to include details of project, demonstration and document verification followed by viva-voce**.** Students should submit both hard copy and soft copy of the presentation slides and thesis verified by guide and project coordinator. 15 marks is awarded to the final document.

The department will appoint a project coordinator who will coordinate the following tasks:

- Dissemination of guidelines provided by the monitoring committee comprising senior faculty members to the students and their guides.
- Scheduling of project reviews.
- Consolidation of project review marks.