ACADEMIC REGULATIONS

COURSE STRUCTURE

AND

DETAILED SYLLABUS

Computer Science and Engineering
(ARTIFICIAL INTELLIGENCE & MACHINE LEARNING)

FOR

B. TECH FOUR YEAR DEGREE COURSE

(Applicable for the batches admitted from 2020-2021)

G. NARAYANAMMA INSTITUTE OF TECHNOLOGY & SCIENCE
(FOR WOMEN)
(Autonomous)
Shaikpet, Hyderabad– 500 104.

G. NARAYANAMMA INSTITUTE OF TECHNOLOGY & SCIENCE
(AUTONOMOUS) (For Women)
Shaikpet, Hyderabad– 500104

B.TECH-ACADEMIC REGULATIONS
(GNITS-R18)
For CBCS Based B.Tech. Degree Courses

(Applicable for the students of B.Tech (Regular) from the Academic Year **2020-21** and onwards)

1.0 Under-Graduate Degree Course (UGDC) in Engineering & Technology (E&T)

G. Narayanamma Institute of Technology & Science (GNITS) - for Women, Hyderabad, affiliated to Jawaharlal Nehru Technological University Hyderabad (JNTUH), Hyderabad, offers 4 Year (8 Semesters) **Bachelor of Technology** (B.Tech.) Degree Course under Choice Based Credit System (CBCS) with effect from the Academic Year **2020-21** onwards in the following Branches of Engineering & Technology:

S.No.	***Branch***
I.	Computer Science & Engineering **(CSE)**
II.	Computer Science & Engineering (Artificial Intelligence & Machine Learning) **(CSM)**
III.	Computer Science & Engineering (Data Science) **(CSD)**
IV.	Electrical & Electronics Engineering **(EEE)**
V.	Electronics & Communication Engineering **(ECE)**
VI.	Electronics & Telematics Engineering **(ETE)**
VII.	Information Technology **(IT)**
VIII.	Computer Science and Technology **(CST)**

2.0 Eligibility for Admission

2.1 The Admission to the UGDC shall be made either on the basis of the merit rank obtained by the qualifying candidate at an Entrance Test conducted by the Telangana State Government (TSEAMCET), OR the University, OR on the basis of any other order of merit approved by the University, subject to the reservations as prescribed by the Government from time to time.

2.2 The medium of instruction for the entire UG Degree Course in E&T shall be ENGLISH only.

3.0 B.Tech. Degree Course Structure

3.1 The B.Tech. Degree Courses at GNITS are of Semester Pattern, with 8 Semesters constituting 4 Academic Years and each Academic Year is of TWO Semesters (First/Odd and Second/Even Semesters). Each Semester shall be of 22 Weeks duration (inclusive of Examinations), with a minimum of 90 Instructional Days per Semester.

3.2 UGC/AICTE specified Definitions/Descriptions are adopted appropriately for various terms and abbreviations used in these Academic Regulations/ Norms, which are listed under **3.2.1 to 3.2.4**. The Course Structure is organized based on the AICTE Model Curriculum for Under-Graduate Degree Courses in Engineering & Technology (Jan. 2018).

3.2.1 Semester Scheme:

Each UGDC is of 4 Academic Years (8 Semesters), with each academic year divided into two semesters of 22 weeks (≥90 working days) each. Each semester has - 'Continuous Internal Evaluation (CIE)' and 'End Semester Examination or Semester End Examination (SEE)'. Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS)

as denoted by UGC, and Course Structure/Curriculum as suggested by AICTE are followed. The terms 'SUBJECT' or 'COURSE' imply the same meaning here, and refers to 'Theory Subject', or 'Lab/Practical Course', or 'Design/ Drawing Subject', or 'Elective', or 'Seminar', or 'Project', or 'Mini-Project', as the case may be.

3.2.2 Credit Courses

All the Subjects/ Courses are to be registered by a student in a Semester to earn Credits. Credits shall be assigned to each Subject/ Course in a **L : T : P : C** (**L**ecture Periods : **T**utorial Periods : **P**ractical Periods : **C**redits) Structure based on the following general pattern:

- One Credit - for One hour/ Week/ Semester for Theory/ Lecture (L) Courses, and Tutorials (T); and,
- One Credit - for Two hours/ Week/ Semester for Laboratory/ Practical (P) Courses.

Student Activity Courses like NCC, NSS, NSO, and other courses identified as Mandatory Courses (MC) shall not carry Credits.

3.2.3 Subject/ Course Classification

All the Subjects/ Courses offered for the UGDC are broadly classified as :
(a) Foundation Courses (FnC), (b) Core Courses (CoC), and (c) Elective Courses (ElC).

- Foundation Courses (FnC) are further categorized as :
  (i) HS (Humanities and Social Sciences including Management Courses),
  (ii) BS (Basic Sciences Courses), and
  (iii)ES (Engineering Sciences Courses);
- Core Courses (CoC) and Elective Courses (ElC) are categorized as PS (Professional Subjects), which are further subdivided as:
  (i) PC (Professional/ Departmental Core) Courses
  (ii) PE (Professional/ Departmental Electives) Courses
  (iii) OE (Open Electives) Courses; and
  (iv) Project Works (PW);
- Additional Courses :
  - ONLINE Courses (offered by IITs/ MOOCs) ; and
- Mandatory Courses :
  - MC - No Credits allocated.

3.2.4 Course Nomenclature:

The Curriculum Nomenclature or Course Structure Grouping for each UG Degree Course (B.Tech. Degree Programmes) is as listed below (along with AICTE specified % Range of Total Credits):

S. No	*Broad Course Classification*	*Course Group/ Category*	*Course Description*	*Range of Credits & AICTE Model Credits*
1)	**Foundation Courses (FnC)**	**BS – Basic Sciences**	Include - Mathematics, Physics, Chemistry, Biology Subjects	**15% - 20%**
2)		**ES - Engineering Sciences**	Include fundamental engineering subjects	**15% - 20%**
3)		**HS – Humanities & Social Sciences**	Include subjects related to Humanities, Social Sciences and Management	**5% - 10%**
4)	**Core Courses (CoC)**	**PC – Professional Core**	Include core subjects related to the Parent Department/ Branch of Engg.	**30% - 40%**

5)	**Elective Courses (ElC)**	**PE – Professional Electives**	Include Elective subjects related to the Parent Department/ Branch of Engg.	**10% - 15%**
6)		**OE – Open Electives**	Elective subjects include subjects from other technical and/ or Emerging Subject Areas	**5% - 10%**
7)	**Projects Related Courses (PW)**	**Project Work**	B.Tech. Project or UG Project or UG Major Project	**10% - 15%**
8)		**Mini-Project**	Mini-Project/Industrial Training / Internship/ UG Mini-Project	
9)		**Seminar**	Seminar based on core contents related to Parent Department/ Branch of Engg.	
10)	**Mandatory Courses**	**MC**	Mandatory Courses	**Non-Credit**
11)	**Additional Courses**	**ONLINE Courses**	Offered by IITs/ MOOCs	Optional
Total Credits for UGDC (B. Tech.) Programme				**160 (100%)**

4.0 Course Work

4.1 A student after securing admission shall pursue the B.Tech. UG Degree Course in a minimum period of 4 Academic Years, and a maximum period of 8 Academic Years (with effect from the Date of Commencement of I Year).

4.2 As suggested by AICTE, a 3-week 'Mandatory Induction Programme' shall be offered for all the Branches of Engineering at the start of the I Year UGDC, to enable the newly admitted students get acquainted with the new professional environment, to develop awareness and understanding of the engineering education requirements, and to get them prepared for the academic schedules ahead. The features, activities and pattern of the Induction Programme shall be as per the guidelines suggested in the Model Curriculum. Conventional class work shall commence only after the completion of the Induction Programme.

4.3 Each student shall Register for and secure the specified number of Credits (160 Credits) required for the completion of the UGDC and the Award of the B.Tech. Degree in the respective Branch of Engineering.

4.4 Each Semester is structured to provide typically about 20 Credits (20 C) on an average, totaling to 160 Credits (160 C) for the entire B.Tech. Programme.

5.0 Course Registration

5.1 A 'Faculty Advisor or Counselor' shall be assigned to each B.Tech student and the faculty advisor assigned shall advise/counsel the student about the UGD Course, its Course Structure and Curriculum, Choice/Option for Subjects/Courses, based on the competence, progress, pre-requisites and interest of the student.

5.2 The Academic/Examination Section of the College invites 'Registration Forms' from the students apriori (before the beginning of the Semester) through 'ONLINE SUBMISSIONS', ensuring 'DATE and TIME Stamping'. The ONLINE Registration Requests for any 'CURRENT SEMESTER' shall be completed BEFORE the commencement of SEEs (Semester End Examinations) of the 'PRECEDING SEMESTER'.

5.3 Every individual student is advised to register for all the number of credits indicated in that semester workload of the respective UGD Course Structure - this is termed as the 'Minimum Work Load' (MWL).

5.4 A student can apply for ONLINE Registration, ONLY AFTER obtaining the 'WRITTEN APPROVAL' from her assigned Faculty Advisor, which should be submitted to the College Academic/Examination Section through the Head of the Department (a copy of the same is to be retained by the Head of the Department, Faculty Advisor and the student).

5.5 A student may be permitted to register for the Subjects/ Courses of her choice with the typical work load suggested in the respective semester credit load allocation of that UG Degree Course Structure as the Minimum Work Load (MWL), and maximum – with possible additional courses of her choice, limited to a Total Work Load (TWL) of 25 C, based on her PROGRESS and SGPA/ CGPA, and completion of the 'PRE-REQUISITES' as indicated for various Subjects/ Courses in the Department Course Structure and Syllabus contents.

5.6 The choice for the 'additional' Subjects/Courses to reach the Maximum Permissible Limit of 25 Credits (above the typical MWL) must be indicated clearly, which needs the specific approval and signature of the Faculty Advisor/ Counselor and the HoD on the hard-copy.

5.7 If the student submits ambiguous choices or multiple options or erroneous entries during ONLINE Registration for the Subject(s) / Course(s) under a given/ specified Course Group/ Category as listed in the Course Structure, only the first mentioned Subject/ Course in that category shall be taken into consideration, as applicable.

5.8 The Subject/Course Options exercised through ONLINE Registration are final and CANNOT be changed, and CANNOT be inter-changed; further, alternate choices shall also be not considered. However, if the Subject/ Course that has already been listed for Registration (by the Head of the Department) in a semester could not be offered on account of any unforeseen or unavoidable reasons, then the student shall be allowed to have alternate choice - either for a new Subject (subject to offering of such a Subject), or for another existing Subject (subject to availability of seats), which may be considered. Such alternate arrangements shall be made by the Head of the Department, with due notification and time-framed schedule, within the FIRST WEEK from the commencement of class-work for that semester.

5.9 Dropping of the Subjects/ Courses may be permitted ONLY AFTER obtaining the prior approval from the Faculty Advisor assigned (subject to the retaining of the MWL), 'within 15 Days of Time' from the beginning of the current semester.

5.10 For the Mandatory Courses (like NCC/ NSS/ NSO etc.), a 'Satisfactory Participation Certificate' from the concerned authorities of the relevant semester is essential. No Marks or Grades or Credits shall be awarded for the Mandatory Courses.

6.0 Subjects/ Courses to be offered

6.1 A typical Section strength (or Class strength) for each semester shall be 60.

6.2 A Subject/ Course may be offered to the students, ONLY IF a Minimum of 30 Students opt for the same. The Maximum Class Strength of a Section is limited to 80.

6.3 More than ONE TEACHER may offer the SAME SUBJECT (Theory/ Tutorials/Lab./Practicals) in any semester. However, selection choice for students will be based on - 'FIRST COME FIRST SERVE Basis and CGPA Criterion' (ie., the first focus shall be on the earliest stamping of ONLINE ENTRY from the student for Registration in that semester, and the second focus, if needed, shall be on the existing CGPA of the student).

6.4 If more entries for the Registration of a Subject come into picture, then the Head of the Department concerned shall take necessary action, whether to offer such a Subject/ Course for TWO (or multiple) SECTIONS or NOT .

6.5 In case of the options coming from the students of the other Departments/ Branches/ Disciplines also (not considering OPEN ELECTIVES), PRIORITY shall be given to the student of the 'Parent Department/Branch' first.

7.0 Attendance Requirements

7.1 A student shall be eligible to appear for the End Semester Examinations if she acquires a minimum of 75% of attendance in aggregate of all the Subjects/Courses (excluding Mandatory or Non-Credit Courses) for that semester.

7.2 Condoning of shortage of attendance in aggregate up to 10% (65% and above, and below 75%) in each semester may be granted by the College Academic Committee (CAC) on genuine and valid grounds based on the student's representation with supporting evidence. Provision of such condonation is however limited to a maximum of 3 times during the maximum permissible UG study period.

7.3 A stipulated fee shall be payable towards condoning of shortage of attendance.

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

7.5 A student, whose shortage of attendance is not condoned in a semester is not eligible to take her End Examinations of that semester; she get detained and her registration for that semester shall stand cancelled. She shall not be promoted to the next semester. She may seek re-registration for all those Subjects registered in that semester in which she gets detained by seeking re-admission for that semester as and when offered; in case if there are any Professional Electives and/ or Open Electives, the same may also be re-registered if offered, however, if those Electives are not offered in later semesters, then alternate Electives may be chosen from the same set of Elective Subjects offered under that Elective category.

8.0 Academic Requirements

The following Academic Requirements have to be satisfied in addition to the Attendance Requirements mentioned under Clause 7.0.

8.1 A student shall be deemed to have satisfied the Academic Requirements and earned the Credits allotted to each Subject/ Course, if she secures not less than 35% marks (25 out of 70 marks) in the End Semester Examination, and a minimum of 40% of marks in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together [in terms of Letter Grades, this implies securing '**C** Grade' or above in that Subject/ Course].

8.2 A student shall be deemed to have satisfied the Academic Requirements and earned the Credits allotted to the Seminar and the Mini-Project, if she secures not less than 40% of the total marks (that is, 40 marks) to be awarded for each. The student would be treated as failed, if she - (i) does not submit a report on her Mini-Project, or does not make a presentation of the same before the Evaluation Committee as per the schedule, or (ii) does not present the Seminar as required in the III year II Semester, or (iii) secures less than 40% of marks (40 marks) in the Mini-Project/ Seminar evaluations. She may have to reappear for the Mini-Project/ Seminar evaluations, when they are scheduled again in that semester; if she fails in such 'one reappearance' evaluation also, she has to reappear for the same in the next subsequent semester, as and when they are scheduled as supplementary candidate.

8.3 A student will not be promoted from the I Year to the II Year, unless she fulfills the Attendance and Academic Requirements and secures a total of 19 Credits out of 38 Credits specified for the I Year, from all the relevant regular and supplementary examinations, whether she takes those examinations or not.

8.4 A student will not be promoted from the II Year to the III Year, unless she fulfills the Attendance and Academic Requirements and secures a total of 47 Credits out of 79 Credits specified up to and inclusive of the II Year II Semester, from all the relevant regular and supplementary examinations, whether she takes those examinations or not.

8.5 A student will not be promoted from the III Year to the IV Year, unless she fulfils the Attendance and Academic Requirements and secures a total of 71 Credits out of 119 Credits specified up to and inclusive of the III Year II Semester, from all the relevant regular and supplementary examinations, whether she takes those examinations or not.

8.6 A student shall register for all the Subjects covering 160 Credits as specified and listed (with the relevant Course/ Subject Classifications as mentioned) in the Course Structure, puts up all the Attendance and Academic requirements for 160 Credits securing a minimum of C Grade (Pass Grade) or above in each Subject, and earns ALL 160 Credits securing SGPA ≥ 5.0 (in each semester), and CGPA (at the end of each successive semester) ≥ 5.0 to successfully complete the UG Degree Course.

8.7 If a student registers for any 'additional Subjects' (in the parent Department or other Departments/Branches of Engg.) other than those listed Subjects totaling to 160 Credits as specified in the Course Structure of her Department, the performances in those 'additional Subjects' (although evaluated and graded) shall not be taken into account while calculating the SGPA and CGPA. For such 'additional Subjects' registered, the Letter Grade alone shall be indicated in the Grade Card as a performance measure subject to the completion of the Attendance and Academic Requirements as stated under Clauses 7.0 and 8.1 – 8.6.

8.8 Students who fail to earn 160 Credits as per the Course Structure, and as indicated above, within 8 Academic Years from the Date of the Commencement of their I Year, shall forfeit their seats in B.Tech. Programme and their admission shall stand cancelled.

8.9 When a student is detained due to the shortage of attendance in any semester, she may be re-admitted into that semester as and when offered, along with the Academic Regulations of the Batch into which she gets readmitted. However, no Grade Allotments or SGPA/ CGPA calculations shall be done for that entire semester in which she got detained.

8.10 When a student is detained due to lack of Credits in any year, she may be readmitted in the next year(s), after the fulfillment of the Academic Requirements, along with the Academic Regulations of the Batch into which she gets readmitted.

8.11 A student who is eligible to appear for the End Semester Examination in any Subject/ Course, but is absent for a particular subject/course or has failed (thereby failing to secure C Grade or above), may reappear for that Subject/ Course at the supplementary examination (SEE) as and when conducted. In such cases, her Internal Marks (CIE) assessed earlier for that Subject/Course shall be retained and carried over, and added to the marks to be obtained in the SEE supplementary examination for evaluating her performance in that Subject.

8.12 In view of AICTE/UGC suggestions and guidelines, it is resolved to recommend the inclusion of **"INTERNSHIP" for B.Tech Programme students**, in the 8^{th} Semester (4^{th} Year 2^{nd} Semester), for One Semester Duration, in addition to the B.Tech. Project requirements already specified, with the following notes …

i. The internship will be "Industry Internship", and is exclusively meant for all those students who have been considered eligible and selected accordingly by the Industry. Based on such selection letters from the Industry, approvals will be given to individual students by the Head of Department and the Principal of the Institution to carry out the Industry Internship for One Semester. The Internship Performance will be evaluated by the Supervisor/Advisor/Guide from the Industry for 100 marks (there will not be any Internals/Sessionals from the department side), and a Certificate is to be issued to that effect from the Industry. The Internship will carry a weightage of 3 Credits, and all students who undergo Internship Programme are exempted from the prescribed Open Elective Course of B.Tech.– 4^{th} Year 2^{nd} Semester (which is also for 3 Credits).

ii. If any student fails to complete this Internship Programme due to any reason whatsoever, or fails to secure at least 50% marks in their Internship Performance Evaluation, she would have to register for the previously exempted Open Elective Course of 4th Year 2nd Semester, in the next subsequent semester(s), as a 'supplementary candidate', and complete all the academic requirements as needed.

iii. Because of the mandatory physical presence of the student required at the Industry during the Internship Period, provision is made to the effect that *students may be permitted to choose ONE ON-LINE Course (of NPTEL/MOOCS level - for 3 Credit Weightage),* ***in place of the existing Professional Elective Course (Professional Elective – 6) in 4th Year 2nd Semester of the B.Tech Programme, preferably in the same domain specialization, subject to acceptance and approval by the Head of Department, during 3rd year – 2nd semester or 4th year- 1st semester, as applicable .*** In such cases, the student's performance evaluation will be as per the ON-LINE Course evaluation format. **If any student fails to get the required Grade/Marks in her ON-LINE Course evaluations, she would have to repeat the same ON-LINE Course again (as and when offered) and complete it successfully, or can register for *Professional Elective – 6 in 4th Year 2nd Semester*** to meet all the academic requirements.

9.0 Evaluation - Distribution and Weightage of Marks

9.1 The performance of a student in each semester shall be evaluated Subject-wise (irrespective of the Credits assigned) with a maximum of 100 marks for Theory, or Labs/ Practicals, or Drawing/Design, or Elective Course, or Seminar, or Mini-Project, or Project – I, or Project – II etc. These evaluations shall be based on 30% CIE (Continuous Internal Evaluation) and 70% SEE (Semester End Examination), and a Letter Grade corresponding to the % of marks obtained shall be given.

9.2 For all the Subjects/ Courses as mentioned under **9.1**, the distribution shall be: 30 Marks for the CIE and 70 Marks for the SEE for the entire UG Degree Course.

9.3 **a)** For the Theory Subjects during the semester, there shall be 2 mid-term examinations for 25 marks each. Each mid-term examination consists of one Objective section for 10 marks, plus one Subjective section for 15 marks, with a total duration of 120 minutes. Further, there shall be an allocation of 5 marks for the Assignment, and there shall be 2 Assignments. The Objective section may be set with multiple choice questions, True/False selections, fill-in the blanks, matching type questions, etc. The Subjective section shall contain 5 questions, out of which the student has to answer any 3 questions, each question carrying 5 marks.

b) The first mid-term examination shall be conducted in the middle of the semester for the first 50% of the syllabus, and the second mid-term examination shall be conducted at the end of the semester for the remaining 50% of the syllabus.

c) The First Assignment should be submitted before the conduct of the first mid-term examination, and the Second Assignment should be submitted before the conduct of the second mid-term examination. The Assignments shall be as specified by the subject teacher concerned.

d) The first mid-term examination marks and the first Assignment Marks combined together shall make one set of CIE marks, and the second mid-term examination marks and the second Assignment Marks shall make the second set of CIE marks; and the AVERAGE of the two sets of mid examination marks shall be taken as the final marks secured by the student towards Continuous Internal Evaluation (CIE) in that Theory Subject.

9.4 For the Lab/Practical Subjects, the Continuous Internal Evaluation (CIE) during the semester shall be for 30 Marks, and the End Semester Examination (SEE) shall be for 70 Marks. Out of the 30 Marks for internals (CIE), day-to-day assessment of the lab work

shall be assessed for 20 Marks; and one internal lab exam shall be conducted by the laboratory teacher concerned for 10 Marks. The Semester End Examination (SEE) for Lab/Practicals shall be conducted at the end of the semester by Two Examiners nominated by the Head of the Department and approved by the Principal.

9.5 For the Subjects with Design and/or Drawing, (such as Engineering Graphics, Engineering Drawing, Machine Drawing, Production Drawing Practice, and Estimation etc.), the distribution shall be: 30 Marks for CIE (20 Marks for the day-to-day work and 10 Marks for the internal tests) and 70 Marks for SEE. There shall be TWO internal tests in a semester and the AVERAGE of the two shall be taken into consideration for the award of Marks for the internal tests (CIE).

9.6 **Open Electives**: 4 Open Elective Courses shall be offered in the 8 Semester UG Degree Course. Students are to choose ONE from each set of Open Electives given. However, students cannot opt for an Open Elective Subject offered by their own (parent) Department, if it has been already listed (or the contents included) under any category of the Subjects offered by the parent department in any semester.

9.7 There shall be a Seminar Presentation in the III Year II Semester. For the Seminar, the student shall collect the information on a technical topic, prepare a Technical Report and submit the Technical Report prepared to the Department at the time of Seminar Presentation. The Seminar Presentation (along with the Technical Report submitted) shall be evaluated for 100 marks by Two Faculty Members assigned by the Head of the Department. There shall be no SEE or external examination for the Seminar.

9.8 **a)** There shall be a Mini-Project, preferably in collaboration with an Industry with the relevant specialization, to be registered immediately after III Year II Semester examinations, and taken up during the summer vacation (between III and IV Years) for about eight weeks duration.

b) The Mini-Project work shall be submitted in a Report form, and a presentation of the same shall be made before a Committee and is evaluated for 100 Marks by the committee. The Committee shall consist of the Head of the Department, the supervisor of Mini-Project, and a Senior Faculty Member of the Department. There shall be no internal marks for Mini-Project. Performance evaluation of the Mini-Project shall be included in the IV Year I Semester Grade Card.

9.9 Each student shall start the Project Work during the IV Year I Semester as per the instructions of the Project Guide/ Project Supervisor assigned by the Head of the Department.

a) The Project Work shall be divided and carried out in 2 phases : Phase – I (Project-I) during IV Year I Semester, and Phase – II (Project-II) during IV Year II Semester, and the student has to prepare two independent Project Work Reports – *one each during each phase*. First Report shall include the Project Work carried out under Phase – I, and the Second Report (Final Report) shall include the Project Work carried out under Phase – I and Phase – II put together. Phase – I and Phase – II of the Project Work shall be evaluated for 100 marks each.

b) Out of the total 100 marks allotted for each Phase of the Project Work, 30 marks shall be for the CIE (Continuous Internal Evaluation/CIE), and 70 Marks shall be for the End Semester Viva-voce Examination/SEE). The Marks earned under CIE for both Phases of the Project shall be awarded by the Project Guide/Supervisor (based on the continuous evaluation of student's performance during the two Project Work Phases/periods); and the marks earned under SEE shall be awarded by the Project Viva-voce Committee/ Board (based on the work carried out, report prepared and the presentation made by the student at the time of Viva-voce Examination).

c) For the Project Phase - I, the Viva-voce shall be conducted at the end of the IV Year I Semester, before the commencement of that Semester End Examinations, at the Department Level by a Committee comprising of the HOD or One Professor and Supervisor (no external examiner), and the Project Phase – II (or Final Project

Viva-voce) shall be conducted by a Committee comprising of an External Examiner, the Head of the Department and the Project Supervisor at the end of the IV Year II Semester, before the the commencement of semester and examinations. The nomination of the External Examiner shall be done by the Principal from the panel of 3 names of external faculty members (Professors or Associate Professors outside the College) submitted by the HOD.

9.10 For NCC/ NSS/ NSO Mandatory Courses and/or any other Mandatory Non-Credit Course offered in a semester, a 'Satisfactory Participation Certificate' shall be issued to the student from the authorities concerned, only after securing ≥ 75% attendance in the Course. No Marks or Letter Grade shall be allotted for the Mandatory Courses.

10.0 Grading Procedure

10.1 Marks shall be awarded to indicate the performance of each student in each Theory Subject, or Lab/Practicals, or Workshop/Drawing, or Elective Course, or Seminar, or Project, or Mini-Project, etc., and, based on the % of marks obtained in CIE + SEE (Continuous Internal Evaluation + Semester End Examination, both taken together) as specified under 9.0, a corresponding Letter Grade shall be given

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

% of Marks Secured (Class Intervals)	*Letter Grade (UGC Guidelines)*	*Grade Points*
90% and above (≥ 90% ,≤ 100%)	**O (Outstanding)**	**10**
Below 90% but not less than 80% (≥ 80% ,< 90%)	**A^+ (Excellent)**	**9**
Below 80% but not less than 70% (≥ 70% ,< 80%)	**A (Very Good)**	**8**
Below 70% but not less than 60% (≥ 60% ,< 70%)	**B^+ (Good)**	**7**
Below 60% but not less than 50% (≥ 50% ,< 60%)	**B (above Average)**	**6**
Below 50% but not less than 40% (≥ 40% ,< 50%)	**C (Pass)**	**5**
Below 40% (< 40%)	**F (FAIL)**	**0**

10.3 A student obtaining **'F'** Grade in any Subject shall be considered 'FAILED' and will be required to reappear as 'Supplementary Candidate' in the End Semester Examination (SEE), as and when conducted. In such cases, her Internal Marks (CIE Marks) in those Subject(s) will remain the same as those obtained earlier.

10.4 A Letter Grade does not imply any specific % of marks.

10.5 In general, a student shall not be permitted to repeat any Subject/ Course (s) for the sake of 'Grade Improvement' or 'SGPA/ CGPA Improvement'. However, she has to repeat all the Subjects/Courses pertaining to that semester, when she is detained (as listed under Clauses 8.9- 8.10).

10.6 A student earns Grade Points (GP) in each Subject/ Course on the basis of the Letter Grade obtained by her in that Subject/Course (excluding Mandatory non-credit Courses). Then the corresponding 'Credit Points' (CP) are computed by multiplying the Grade Point with Credits for that particular Subject/Course.

Credit Points (CP) = Grade Points (GP) * Credits for a Course

10.7 The student passes the Subject/ Course only when she gets GP ≥ 5 (C Grade or above).

10.8 The Semester Grade Point Average (SGPA) is calculated by dividing the Sum of Credit Points (ΣCP) secured from ALL Subjects/ Courses registered in a semester by the Total Number of Credits registered during that semester. SGPA is rounded off to TWO Decimal Places. SGPA is thus computed as

SGPA = $\{\sum_{i=1}^{N} c_i g_i\} / \{\sum_{i=1}^{N} c_i\}$ …. for each Semester

where 'i' is the Subject indicator index (takes into account all Subjects in a semester), 'N' is the no. of Subjects 'REGISTERED' for the semester (as specifically required and listed under the Course Structure of the parent Department), c_i is the no. of Credits allotted to the ith Subject, and g_i represents the Grade Points (GP) corresponding to the Letter Grade awarded for that ith Subject.

10.9 The Cumulative Grade Point Average (CGPA) is a measure of the overall cumulative performance of a student over all the semesters considered for registration. The CGPA is the ratio of the Total Credit Points secured by a student in ALL the registered Courses in ALL the semesters, and the Total Number of Credits registered in ALL the semesters. CGPA is rounded off to TWO Decimal Places. CGPA is thus computed from the I Year Second Semester onwards at the end of each semester as per the formula

CGPA=$\{\sum_{j=1}^{M} c_j g_j\}/\{\sum_{j=1}^{M} c_j\}$…for all S semesters registered (ie., up to and inclusive of S semesters, S ≥ 2),

where 'M' is the TOTAL no. of Subjects (as specifically required and listed under the Course Structure of the parent Department) the student has 'REGISTERED' from the 1st Semester onwards upto and inclusive of the semester S (obviously M > N), 'j' is the Subject indicator index (takes into account all Subjects from 1 to S semesters), c_j is the no. of Credits allotted to the jth Subject, and g_j represents the Grade Points (GP) corresponding to the Letter Grade awarded for that jth Subject. After the registration and completion of I Year I Semester however, the SGPA of that semester itself may be taken as the CGPA, as there are no cumulative effects.

10.10 For the Merit Ranking or Comparison Purposes or any other listing, ONLY the 'ROUNDED OFF' values of the CGPAs shall be used.

10.11 For Calculations listed under Clauses 10.6 – 10.10, performance in failed Subjects/ Courses (securing F Grade) shall also be taken into account, and the Credits of such Subjects/ Courses shall also be included in the multiplications and summations. However, Mandatory Courses will not be taken into consideration.

10.12 Passing Standards

10.12.1 A student shall be declared successful or 'passed' in a semester, only when she gets a SGPA ≥ 5.00 (at the end of that particular semester); and a student shall be declared successful or 'passed' in the entire UG Degree Course, only when she gets a CGPA ≥ 5.00; subject to the condition that she secures a GP ≥ 5 (C Grade or above) in every registered Subject/ Course in each semester (during the entire UG Degree Course) for the Award of the Degree, as required.

10.12.2 A student shall be declared successful or 'passed' in any Non-Credit Subject/ Course, if she secures a 'Satisfactory Participation Certificate' for that Mandatory Course.

10.13 After the completion of each semester, a Grade Card or Grade Sheet (or Transcript) shall be issued to all the Registered Students of that semester indicating the Letter Grades and the Credits earned. The Grade Card or the Grade Sheet shall show the details of the Courses Registered (Course Code, Title, No. of Credits, Grade Earned etc.), Credits earned, SGPA, and CGPA.

11.0 Declaration of Results

11.1 Computation of SGPA and CGPA are done using the procedure listed under Clauses 10.6 – 10.10.

11.2 CGPA is NOT indicative of the % of marks secured. However, in case if % of marks equivalent to the FINAL CGPA (computed at the end of UG Degree Course) is required, then the following formula may be used as an estimate:

% of Marks = (final CGPA – 0.5) x 10

12.0 Award of Degree

12.1 A student who registers for all the specified Subjects/ Courses as listed in the Course Structure, satisfies all the Course Requirements, and passes all the examinations prescribed in the entire UG Degree Course, and secures the required number of 160 Credits (with CGPA ≥ 5.0), within 8 Academic Years from the Date of Commencement of the First Academic Year, shall be declared to have 'QUALIFIED' for the Award of the B.Tech. Degree in the chosen Branch of Engineering as selected at the time of Admission.

12.2 A student who qualifies for the Award of the Degree as listed under Clause 12.1, shall be placed in the following four Classes :

12.2.1 a) A student with final CGPA (at the end of the UG Degree Course) ≥ 8.00, and fulfilling the following conditions -

(i) should have passed all the Subjects/Courses in 'FIRST APPEARANCE' within the first 4 Academic Years (or 8 Sequential Semesters) from the Date of Commencement of her First Academic Year,

(ii) should have secured a CGPA ≥ 8.00, at the end of each of the 8 sequential semesters, starting from the I Year I Semester onwards,

(iii)should not have been detained or prevented from writing the End Semester Examinations in any semester due to shortage of attendance or any other reason,

SHALL be placed in 'FIRST CLASS with DISTINCTION'.

b) A student with final CGPA (at the end of UG Degree Course) ≥ 8.00, but not fulfilling the above conditions, shall be placed in 'FIRST CLASS'.

12.2.2 A student with final CGPA (at the end of the UG Degree Course) ≥ 6.50 but <8.00, shall be placed in 'FIRST CLASS'.

12.2.3 A student with final CGPA (at the end of the UG Degree Course) ≥ 5.50 but <6.50, shall be placed in 'SECOND CLASS'.

12.2.4 All other students who qualify for the Award of the Degree (as per the Clause 12.1), with final CGPA (at the end of the UG Degree Course) ≥ 5.00 but < 5.50, shall be placed in 'PASS CLASS'.

12.2.5 A student with final CGPA (at the end of the UG Degree Course) < 5.00 will not be eligible for the Award of the Degree.

12.2.6 A student fulfilling the conditions listed under the Clause 12.2.1 (a) alone will be the eligible candidate for the 'University/College Rank' and/or 'Gold Medal' considerations.

13.0 Withholding of Results

13.1 If the student has not paid fees to the University/ College at any stage, or has pending dues against her name due to any reason whatsoever, or if any case of indiscipline is pending against her, the result of the student may be withheld, and she shall not be allowed to go into the next higher semester. The award or issue of the Degree may also be withheld in such cases.

14.0 Transitory Regulations

14.1 A student who has discontinued for any reason, or has been detained for want of attendance or lack of required credits as specified, or who has failed in her B.Tech. Degree Course after the UGDC period of 4 years, may be considered eligible for

readmission to the same Subjects/ Courses (or equivalent Subjects/ Courses, as the case may be), and/ or to the same Professional Electives/ Open Electives (from the same set/category of Electives available or equivalents suggested, as the case may be) as and when she is offered (within the time-frame of 8 years from the Date of Commencement of her I Year I Semester), along with the Academic Regulations of the Batch into which she gets readmitted.

15.0 Student Transfers

15.1 There shall be no Branch transfers after the completion of the Admission Process.

16.0 Scope

i) Where the words "Subject" or "Subjects", occur in these regulations, they also imply "Course" or "Courses".

ii) The Academic Regulations should be read as a whole, for the purpose of any interpretation.

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

iv) The College may change or amend the Academic Regulations, Course Structure or Syllabi at any time, and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the College Authorities.

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G. NARAYANAMMA INSTITUTE OF TECHNOLOGY & SCIENCE (For Women)
(AUTONOMOUS)
Shaikpet, Hyderabad– 500104
ACADEMIC REGULATIONS

For CBCS Based B.Tech. Degree Courses for Students Admitted under Lateral Entry Scheme (LES)

(Effective for the students admitted into II year from the Academic Year **2021-22** and onwards)

A) Eligibility for Admission

A.1 The Admission to the B.Tech. Programme (UG Degree Course) shall be made either on the basis of the merit rank obtained by the qualifying candidate at an Entrance Test conducted by the Telangana State Government (TSECET), OR the University, OR on the basis of any other order of merit approved by the University, subject to the reservations as prescribed by the Government from time to time.

B) B.Tech. Degree Course Structure for LES Students ~

B.1 Regular Full Time B.Tech. Degree Courses at GNITS are of Semester Pattern, with 8 Semesters constituting 4 Academic Years and each Academic Year is of TWO Semesters (First/Odd and Second/Even Semesters). Students admitted under LES shall join - the II Year stream of the Regular B.Tech. students in the relevant branch of engineering (Admitted for 4 Year UG Degree Course in the previous year) and their UG Degree Course period therefore shall be 3 Years (II, III and IV Years) or 6 Semesters of the Regular Full Time B.Tech. Programme (commencing from II Year I Semester).

B.2 The LES Students, after securing admission, shall pursue their UG Degree course of study for not less than 3 years and not more than 6 years, from the year of admission.

B.3 Each student shall Register for and secure the specified number of Credits (122 Credits) required for the completion of the UGDC and the Award of the B.Tech. Degree in the respective Branch of Engineering.

C) Academic Requirements ~

C.1 A student will not be promoted from the II Year to the III Year, unless she fulfills the Attendance and Academic Requirements and secures a total of 24 Credits out of 41 Credits specified up to and inclusive of the II Year II Semester, from all the relevant regular and supplementary examinations, whether she takes those examinations or not.

C.2 A student will not be promoted from the III Year to the IV Year, unless she fulfils the Attendance and Academic Requirements and secures a total of 48 Credits out of 81 Credits specified up to and inclusive of the III Year II Semester, from all the relevant regular and supplementary examinations, whether she takes those examinations or not.

C.3 A student shall register for all the Subjects covering 122 Credits as specified and listed (with the relevant Course/ Subject Classifications as mentioned) in the Course Structure, puts up all the Attendance and Academic requirements for 122 Credits securing a minimum of **'C'** Grade (Pass Grade) or above in each Subject, and earns ALL 122 Credits securing SGPA ≥ 5.0 (in each semester), and ≥ 5.0 CGPA (at the end of each successive semester), to successfully complete the B.Tech. Degree Course.

C.4 A student who fails to earn 122 Credits specified as per the Course Structure, and as indicated above, within 6 Academic Years from the year of admission (that corresponds to the II Year I Semester of the Regular Full Time B.Tech. Degree Course), shall forfeit their seat in B.Tech. Programme and their admission shall stand cancelled.

D) Award of Degree

D.1 A student who registers for all the specified Subjects/ Courses as listed in the Course Structure, satisfies all the Course Requirements, and passes all the examinations prescribed in the entire UG Degree Course, and secures the required number of 122 Credits (with CGPA ≥ 5.0), within 6 Academic Years from the year of admission, shall be declared to have 'QUALIFIED' for the Award of the B.Tech. Degree in the chosen Branch of Engineering as selected at the time of Admission.

D.2 A student who qualifies for the Award of the Degree as listed under Clause **D.1**, shall be placed in the following Classes :

D.2.1 a) A student with final CGPA (at the end of the UG Degree Course) ≥ 8.00, and fulfilling the following conditions -

(i) should have passed all the Subjects/Courses in 'FIRST APPEARANCE' within the first 3 Academic Years (or 6 Sequential Semesters) from the year of admission,

(ii) should have secured a CGPA ≥ 8.00, at the end of each of the 6 sequential semesters, starting from the II Year I Semester onwards,

(iii)should not have been detained or prevented from writing the End Semester Examinations in any semester due to shortage of attendance or any other reason, SHALL be placed in 'FIRST CLASS with DISTINCTION'.

b) A student with final CGPA (at the end of UG Degree Course) ≥ 8.00, but not fulfilling the above conditions, shall be placed in 'FIRST CLASS'.

D.2.2 A student fulfilling the conditions listed under the Clause D.2.1 (a) alone will be the eligible candidate for the 'University/College Rank' and/or 'Gold Medal' considerations.

D.2.3 All other clauses (and the corresponding CGPAs) shall be same as those listed under clauses 12.2.2 to 12.2.5.

E) Other Regulations

All the Academic Regulations as applicable for the B.Tech. 4 Year Degree Course students shall hold good for the B.Tech. Lateral Entry Scheme students also, but for the variations as described above, under Clauses A, B, C and D for LES students.

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MALPRACTICES RULES DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

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

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

7	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall .	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred for two consecutive semesters from class work and all end examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of seat.
8	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/ year. The student is also debarred and forfeits the seat
9	If student of the college, who is not a student for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred and forfeits the seat. Person(s) who do not belong to the college will be handed over to police and, a police case will be registered against them.
10	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the student has appeared including practical examinations and project work of that semester/year examinations.
12	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the Principal for further action to award suitable punishment.	

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B.Tech. 4 Year (8 semesters) Regular Programme in
Computer Science and Engineering (AI & ML)
COURSE STRUCTURE

(Applicable for the Batch admitted from the Academic Year 2020-21 onwards)

I YEAR **I SEMESTER**

S. No.	Group	Subject	L	T	P	Credits
1	BS	Chemistry	3	1	-	4
2	BS	Linear Algebra and Multivariable Calculus	3	1	-	4
3	ES	Basic Electrical Engineering	3	1	-	4
4	ES	Programming for Problem Solving	3	-	-	3
5	BS	Chemistry Lab	-	-	2	1
6	ES	Basic Electrical Engineering Lab	-	-	3	1.5
7	ES	Programming Lab	-	-	3	1.5
8	MC	Games and Sports	2	-	-	-
		TOTAL	**14**	**3**	**8**	**19**

I YEAR **II SEMESTER**

S. No.	Group	Subject	L	T	P	Credits
1	BS	Physics	3	1	-	4
2	BS	Numerical Techniques and Transform Calculus	3	1	-	4
3	HS	English	2	-	-	2
4	ES	Engineering Graphics	1	-	3	2.5
5	BS	Physics Lab	-	-	3	1.5
6	HS	English Professional and Communication Skills Lab	-	-	2	1
7	ES	Computational Mathematics Lab	-	-	3	1.5
8	ES	Engineering Workshop	1	-	3	2.5
9	MC	National Service Scheme (NSS)	2	-	-	-
		TOTAL	**12**	**2**	**14**	**19**

Games & Sports / NSS: Participation Certificate is Mandatory for each semester

B.Tech. 4 Year (8 semesters) Regular Programme in

Computer Science and Engineering (AI & ML)
COURSE STRUCTURE

(Applicable for the Batch admitted from the Academic Year 2020-21 onwards)

II YEAR **I SEMESTER**

S.No.	Group	Subject	L	T	P	Credits
1	BS	Probability and Statistics	3	-	-	3
2	BS	Discrete Mathematics	3	-	-	3
3	ES	Digital Logic Design	3	-	-	3
4	PC	Data Structures using C	3	1	-	4
5	PC	Database Management Systems	3	-	-	3
6	ES	IT Workshop and Python Programming Lab	-	-	3	1.5
7	PC	Data Structures using C Lab	-	-	3	1.5
8	PC	Database Management Systems Lab	-	-	3	1.5
9	MC	Gender Sensitization	2	-	-	-
		TOTAL	**17**	**1**	**9**	**20.5**

II YEAR **II SEMESTER**

S. No.	Group	Subject	L	T	P	Credits
1	HS	Managerial Economics and Financial Analysis	3	-	-	3
2	PC	Computer Organization and Architecture	3	-	-	3
3	PC	Operating Systems	3	-	-	3
4	PC	Object Oriented Programming	3	1	-	4
5	PC	Introduction to Artificial Intelligence	3	-	-	3
6	PC	Operating Systems Lab	-	-	3	1.5
7	PC	Object Oriented Programming through Java Lab	-	-	3	1.5
8	PC	Computer Organization and Microprocessor Lab	-	-	3	1.5
9	MC	Environmental Sciences	2	-	-	-
		TOTAL	**17**	**1**	**9**	**20.5**

B.Tech. 4 Year (8 semesters) Regular Programme in

Computer Science and Engineering (AI & ML)
COURSE STRUCTURE

(Applicable for the Batch admitted from the Academic Year 2020-21 onwards)

III YEAR **I SEMESTER**

S. No.	Group	Subject	L	T	P	Credits
1	HS	Fundamentals of Management	3	-	-	3
2	PC	Data Visualization	3	-	-	3
3	PC	Computer Networks	3	1	-	4
4	PE	Professional Elective-1	3	-	-	3
5	OE	Open Elective – 1	3	-	-	3
6	HS	Employability and Soft skills Lab	-	-	2	1
7	PC	Computer Networks Lab	-	-	3	1.5
8	PC	Data Visualization Lab	-	-	3	1.5
		TOTAL	**15**	**1**	**8**	**20**

Professional Elective – 1
Software Engineering
Distributed Systems
Automata and Compiler design

III YEAR **II SEMESTER**

S. No.	Group	Subject	L	T	P	Credits
1	PC	Design and Analysis of Algorithms	3	-	-	3
2	PC	Introduction to Machine Learning	3	-	-	3
3	PC	Data Mining and Predictive Analytics	3	-	-	3
4	PE	Professional Elective -2	3	-	-	3
5	OE	Open Elective – 2	3	-	-	3
6	PC	Machine Learning and Predictive Analytics Lab	-	-	4	2
7	PE	Professional Elective -2 Lab	-	-	2	1
8	PW	Seminar	2	-	-	2
		TOTAL	**17**	**-**	**6**	**20**

Professional Elective – 2	Professional Elective – 2 Lab
Web Development Technologies	Web Development Technologies Lab
Computer Vision and Pattern Recognition	Computer Vision and Pattern Recognition Lab
Internet of Things and Applications	Internet of Things and Applications Lab

B.Tech. 4 Year (8 semesters) Regular Programme in
Computer Science and Engineering (AI & ML)
COURSE STRUCTURE

(Applicable for the Batch admitted from the Academic Year 2020-21 onwards)

IV YEAR **I SEMESTER**

S. No.	Group	Subject	L	T	P	Credits
1	HS	Entrepreneurship and Project Management	3	-	-	3
2	PC	Neural Networks and Deep Learning	3	-	-	3
3	PE	Professional Elective – 3	3	-	-	3
4	PE	Professional Elective – 4	3	-	-	3
5	OE	Open Elective – 3	3	-	-	3
6	PC	Neural Networks and Deep Learning Lab	-	-	2	1
7	PW	Mini Project *	-	-	-	2
8	PW	Project Phase– I	1	-	4	3
		TOTAL	**16**	**-**	**6**	**21**

***Summer between III & IV Year: Mini Project**

Professional Elective – 3	Professional Elective – 4
Fuzzy Logic and Applications	Cloud Computing and Virtualization
Data Science using R	Speech and Natural Language Processing
Big Data Analytics	Information Retrieval Systems

IV YEAR **II SEMESTER**

S. No.	Group	Subject	L	T	P	Credits
1	PC	Network Security	3	-	-	3
2	PE	Professional Elective – 5	3	-	-	3
3	PE	Professional Elective – 6	3	-	-	3
4	OE	Open Elective – 4	3	-	-	3
5	PW	Project Phase– II	2	-	12	8
		TOTAL	**14**	**-**	**12**	**20**

Professional Elective – 5	Professional Elective – 6
Game Theory	Software Project Management
Human Computer Interaction	Real time systems
Digital Forensics	Augmented and Virtual Reality

LIST OF OPEN ELECTIVES OFFERED BY VARIOUS DEPARTMENTS FOR B.TECH.

S.No	Name of the Department Offering Open Electives	Open Elective-1 (B.Tech III Year I Semester)	Open Elective-2 (B.Tech III Year II Semester)	Open Elective-3 (B.Tech IV Year I Semester)	Open Elective-4 (B.Tech IV Year II Semester)
1	**CSE/IT**	➢ Fundamentals of Data Structures ➢ Java Programming	➢ Operating Systems ➢ Database Management Systems	➢Cyber Security ➢Python Programming ➢Android Programming	➢Principles of Artificial Intelligence ➢Cloud Computing
2	**CSE (AI&ML)**	-	➢ Cyber Security	➢ Distributed and Cloud Computing	➢ Distributed and Cloud Computing
3	**CSE (DS)**	-	➢ Cyber Security	➢ Distributed and Cloud Computing	➢Distributed and Cloud Computing
4	**CST**	-	➢ Cyber Security	➢ Blockchain Technologies	➢Blockchain Technologies
5	**ECE/ETM**	➢ Basic Electronics	➢ Principles of Electronic Communications	➢ Telecommunication Switching Systems	➢Cellular and Mobile Communications
6	**EEE**	➢ Electric Materials	➢ Renewable Energy Sources	➢ Waste Management Techniques and Power Generation	➢Robotics
7	**Mechanical**	➢ Operations Research	➢ Operations Research	-	-
8	**H&M**	➢ Introduction to Data Analytics ➢ Intellectual Property Rights	➢ Behavioral Skills And Professional Communication ➢ Intellectual Property Rights	➢ Industrial Management	➢Marketing Management
9	**BS**	➢ Disaster Management	-	-	➢Environmental Impact Assessment

Note: Open Elective- Students should take Open Electives from List of Open Electives Offered by Other Departments/Branches Only.

Ex: A Student of Computer Science and Engineering can take Open Electives from all other departments/branches except Open Electives offered Computer Science and Engineering Dept.

I Year B.Tech. CSE (AI&ML) I-Semester	**L**	**T**	**P**	**C**
Course Code: BS121AA	**3**	**1**	**-**	**4**

CHEMISTRY

(Common to CSM & CSD)

Prerequisites: -Nil-

Course Objectives:

1. To bring adaptability to new developments in engineering chemistry and to acquire the skills required to become a perfect engineer.
2. To include the importance of water in industrial usage, significance of corrosion control to protect the structures.
3. To acquire the knowledge of reaction mechanisms involved in various organic reactions.

UNIT 1: (~ 8 Lecture Hours)

Molecular Structure and Theories of Bonding: Atomic and molecular orbitals: Linear combination of atomic orbitals (LCAO), molecular orbitals of diatomic molecules. Molecular orbital energy level diagrams of diatomic molecules, N_2, O_2 and F_2. ∏ Molecular orbital diagrams of butadiene, benzene and aromaticity.

Crystal Field Theory (CFT): Salient Features of CFT: Crystal field splitting patterns of transition metalion d-orbitals in tetrahedral, octahedral and square planar complexes. Magnetic properties: Spin only magnetic moments of transition metals of d^2-d^9 configuration in octahedral complexes. Band structure of solids and effect of doping on conductance.

UNIT 2: (~ 12 Lecture Hours)

Electrochemistry and Corrosion: Electrochemistry: Conductance: Specific, equivalent and molar conductance and their interrelationship and numerical problems. Electrochemical cell: Electrode potential, standard electrode potential and emf of the cell. Nernst equation, its derivation and applications. Types of electrodes: Standard hydrogen electrode, calomel electrode and glass electrode. Electro chemical series and its applications. Concept of concentration cells: Electrolytic concentration cell and numerical problems. Batteries: Lead acid storage battery and lithium ion battery.

Corrosion: Causes and effects of Corrosion: Theories of chemical and electrochemical corrosion. Mechanism of electrochemical corrosion. Types of corrosion: Galvanic, waterline and pitting corrosion. Factors affecting rate of corrosion. Corrosion control methods: Cathodic protection-Sacrificial anode and impressed current cathodic methods. Surface coatings: Metallic coatings –hot dipping: galvanizing and tinning. Electroplating: Copper plating and electroless plating - Nickel plating.

UNIT 3: (~ 8 Lecture Hours)

Periodic Properties and Nanomaterials: Periodic table: Electronic configurations, atomic and ionic sizes, ionizationenergies, electronaffinity and electronegativity. Variations of s,p,d,f orbital energies of atoms in periodic table. Co-ordination numbers and geometries. Hard and soft acids and bases. HSAB rule and its applications.

Nanomaterials: Synthesis: Top down and bottom up approaches. Properties and applications of fullerenes, carbon nanotubes. General applications of nanomaterials.

UNIT 4: (~ 8 Lecture Hours)

Water and its treatment: Hardness of water: Causes of hardness and types of hardness - temporary and permanent. Expression and units of hardness. Estimation of hardness of water by complexometric method and numerical problems. Potable water and its specifications. Steps involved in treatment of potable water: Disinfection of potable water by chlorination and ozonisation. Boiler troubles: Scales, sludges, priming, foaming and caustic embrittlement. Boiler feed water: Internal treatment by calgon, phosphate and

colloidal conditioning and external treatment of Water by Ion exchange process. Desalination of water: Reverse osmosis. Sewage and its treatment: primary, secondary and tertiary treatments.

UNIT 5: (~ 11 Lecture Hours)
Stereochemistry, Reaction Mechanism and Synthesis of Drug Molecules: Representation of 3 -Dimensional structures: Structural and stereo isomers, configurations. Chirality, enantiomers, diastereomers, optical activity and absolute configuration. Conformation analysis of n- butane. Isomerism in transition metal complexes.
Substitution reactions: Nucleophilic substitution reactions, mechanism of SN^1 and SN^2 reactions. Addition reaction: Electrophilic and Nucleophilic addition. Addition of HBr to Propene: Markownikoff and anti Markownikoff additions. Grignard reactions on carbonyl compounds. Elimination reactions: Dehydrohalogenation of alkyl halides - Saytzeff rule. Oxidation reactions: Oxidation of alcohols using $KMnO_4$ and Chromic acid. Reduction reactions: Reduction of carbonyl compounds using $LiAlH_4$ and $NaBH_4$. Synthesis of Drug molecules: Paracetamol and aspirin.

Text Books:

1. P.C Jain and Jain Monika, Engineering Chemistry, 16th Edition, DhanpatRai Publication Company.
2. Morison and Boyd, Organic Chemistry, 7th Edition, Pearson publications.
3. B.Rama Devi, Ch. VenkataRamana Reddy and PrasanthRath, Text Book of Engineering Chemistry, Cengage Learning.

Reference Books:

1. B.H.Mahan University Chemistry, Addison –Wesley Publishing Company.
2. M.J.Sienko and R.A.Plane, Chemistry: Principles and Applications, McGraw Hill International.
3. J.D.Lee, Concise inorganic Chemistry, 5th Edition, Oxford Publication.
4. K.P.CVolhadt and N.E Schore, Organic Chemistry: “Structure and Function”, 7th Edition, Freeman publications.
5. B.R.Puri, L.R.Sharma and Patani, Principles of Physical Chemistry, 6th Edition, McGraw-Hill Publication.

Online Resources:

1. htttp://www.nptelvideos.in/2017/10/engineering chemistry.html.
2. http://www.nptel.ac.in/engineering chemistry courses.

Course Outcomes:
After completion of the course, students will be able to

1. Analyze microscopic chemistry in terms of atomic and molecular orbitals.
2. Students will gain the basic knowledge of electrochemical procedures related to corrosion and its control.
3. Rationalize periodic properties such as ionization potential, electronegativity and oxidation states.
4. Students can develop and apply the concepts to identify the hardness and boiler troubles of water.
5. List major chemical reactions that are used in the synthesis of drugs.
6. Students can develop and apply the concepts for the solutions of complex engineering problems.

I Year B.Tech. CSE (AI&ML) I-Semester	**L**	**T**	**P**	**C**
Course Code: BS121AB	**3**	**1**	**-**	**4**

LINEAR ALGEBRA AND MULTI VARIABLE CALCULUS

(Common to CST, CSM & CSD)

Prerequisites: -Nil-

Course Objectives:

1. To learn the concepts of rank of a matrix and applying it to understand the consistency of system of equations.
2. To solve system of linear equations.
3. To study properties of Eigen values and Eigen vectors.
4. To find extreme values for functions of several variables.
5. To find the solutions of first, higher order ODE.
6. To evaluate the double and triple integrals for functions of several variables.

UNIT1: (∼ 8 Lecture Hours)

Linear System of Equations - Types of real matrices and complex matrices, rank, echelon form, normal form, consistency and solution of linear systems (homogeneous and Non-homogeneous), LU decomposition method.

UNIT 2: (∼ 8 Lecture Hours)

Eigen values and Eigen Vectors - Eigen values, Eigen vectors and their properties. Cayley - Hamilton theorem (without proof), Inverse and powers of a matrix using Cayley - Hamilton theorem, Diagonalization.

UNIT 3: (∼ 12 Lecture Hours)

Differential Equations – Linear, Bernoulli's, Exact Differential Equations, Differential Equations Reducible to exact, Orthogonal trajectories.

Linear differential equations of higher order with constant coefficients: Non-homogeneous differential equations with RHS term of the type $e^{ax}, sinax, cosax$, polynomials in x, $e^{ax}V(x), xV(x)$, Method of variation of parameters, Applications to Electrical circuits.

UNIT 4: (∼ 10 Lecture Hours)

Functions of Several Variables – Limit & Continuity (Definitions), Partial derivatives, Chain rules, total derivative, differentiation of implicit functions, Jacobian, functional dependency. Maxima and minima of functions of two variables (with and without constraints) and Lagrange's method of undetermined multipliers.

UNIT 5: (∼ 10 Lecture Hours)

Multiple Integrals - Double and triple integrals, change of variables, Change of order of integration.

Applications: Finding areas as double integral and volumes as triple integrals.

Text Books:

1. Dr. B. S. Grewal, Higher Engineering Mathematics, 45th Edition, Khanna Publishers.
2. N. P. Bali, Engineering Mathematics, 1st Edition, Lakshmi Publications.

Reference Books:

1. B.V.Ramana, Higher Engineering Mathematics, 1st Edition, Tata McGraw-Hill Publications.
2. E.Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley and Sons Publisher.
3. Srimanta Pal, SubodhC.Bhunia, Engineering Mathematics, 1st Edition, Oxford Higher Education.

Online Resources:

1. http://www.nptelvideos.in/2012/11/mathematics.html
2. http://nptel.ac.in/courses/111106051/

Course Outcomes:

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

1. Solve and analyze the solution for the system of equations.
2. Compute the Eigen values and Eigen vectors which come across under linear transformations.
3. Determine the extreme values of functions of two variables with/ without constraints.
4. Find the solutions of ordinary differential equations.
5. Evaluate double and triple integrals.
6. Apply the knowledge of mathematics for real situations.

I Year B.Tech. CSE (AI&ML) I-Semester **L T P C**
Course Code: ES121AD **3 1 - 4**

BASIC ELECTRICAL ENGINEERING

(Common to CSM & CSD)

Prerequisites: -Nil-

Course Objectives:

1. To introduce the concepts of Basic Electrical parameters.
2. To analyze basic concepts of AC & DC circuits.
3. To carry out operational analysis of Electrical Machines, Transformers and power converters.

UNIT 1: (~ 10 Lecture Hours)
Magnetic Circuits and DC Circuits
Magnetic Circuits: Magnetic circuits - MMF, flux, reluctance, Inductance; B-H curve of magnetic materials; Minimization of Hysteresis and Eddy current losses.
DC Circuits: Electrical Circuit elements: R, L and C, voltage and current sources, Star – Delta Transformation, Kirchoff's laws, Nodal and Mesh analysis of simple circuits with dc excitation, Superposition, Thevenin's and Norton's Theorems with independent sources- Simple Problems.

UNIT 2: (~ 8 Lecture Hours)
AC Circuits
1-Ø *AC Circuits:* Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor; Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations, series and parallel resonance.
3-Ø *AC Circuits:* Three phase balanced circuits, voltage and current relations in star and delta connections – Simple Problems.

UNIT 3: (~ 10 Lecture Hours)
DC Machines and Transformers
Basic Concepts: Faraday's laws of Electromagnetic induction – statically & dynamically induced emf-Lenz's law – Fleming's Right hand rule.
DC Machines: Principle of operation – Construction - working; Types of DC machines- EMF and Torque equation; Torque-Speed characteristics and speed control of separately excited DCMotor - Numerical problems.
Transformers: Ideal and practical transformer, EMF equation, Simple Problems.
Equivalent circuit - losses in transformers, Three phase transformer connections (Descriptive treatment only).

UNIT 4: (~ 9 Lecture Hours)
AC Machines (Descriptive treatment only)
3-Ø Induction motors: Principle of Operation, Construction of a Three-Phase Induction Motor; Production of rotating magnetic field; slip- frequency of rotor emf – starting Torque – Torque under running conditions. Torque - Slip characteristics.
Induction motors: Basic concepts of 1-ØInduction motors: Split-phase Induction Motor;
Synchronous Machines: Principle of Operation of Synchronous Generators.

UNIT 5: (~ 8 Lecture Hours)
Power Converters & Switchgear (Descriptive treatment only)
Basic Concepts: Basic Semiconductor Devices: Diode, Transistor, SCR;
Power Converters*:* DC-DC Buck and Boost Converters; Single Phase Inverters- Half & Full, Bridge Configuration (Elementary treatment only).

***Switchgear**:* Introduction to Components of LT (Low Tension) Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB. Types of Wires and Cables, Earthing.

Text Books:

1. T.K.Nagasarkar and M.S.Sukhija, Basic Electrical Engineering, 3rd Edition 2018, Oxford University Press.
2. V.K Mehta, Rohit Mehta, Principles of Electrical Engineering, S.Chand Publications.

Reference Books:

1. D.P.Kothari and I.J.Nagrath, Basic Electrical Engineering, Tata McGraw Hill, 2010.
2. V.DelToro, Electrical Engineering Fundamentals, Prentice Hall India, 1989.
3. D.C.Kulshreshtha, Basic Electrical Engineering, McGraw Hill, 2009.

Course Outcomes:

After completion of this course, students will be able to

1. Analyze the basic circuits with application of Network Reduction Techniques and Network Theorems.
2. Understand and analyze magnetic circuits.
3. Analyze the working principles of electrical machines and power converters.
4. Understand the components of low voltage electrical installations.
5. Apply the above conceptual theories to real world Electrical & Electronic problems and applications.
6. Understand and apply the Knowledge of various types of protective systems in real time.

I Year B.Tech. CSE (AI&ML) I-Semester **L T P C**
Course Code: ES121AF **3 - - 3**

PROGRAMMING FOR PROBLEM SOLVING

(Common to CST, CSM & CSD)

Prerequisites: -Nil-

Course Objectives:

1. Learn the fundamentals of computers.
2. Understand the various steps in program development.
3. Learn the syntax and semantics of C programming Language.
4. Learn how to write modular and readable C programs.
5. Learn to write programs using structured programming approach in C to solve problems.

UNIT 1: (~ 10 Lecture Hours)
Introduction to Computers – Computer Systems, Computing Environments, Computer Languages, Creating and running programs, Program Development, algorithms and flowcharts, Number systems - Binary, Decimal, Hexadecimal and Conversions. Introduction to C Language – Background, C Programs, Identifiers, Types, Variables, Constants, Input / Output, Operators (Arithmetic, relational, logical, bitwise etc.), Expressions, Precedence and Associativity, Expression Evaluation, Type conversions.
Statements - Selection Statements (making decisions) – if and switch statements.

UNIT 2: (~ 10 Lecture Hours)
Repetition statements (loops) - while, for, do-while statements, Loop examples, other statements related to looping – break, continue.
Arrays – Concepts, using arrays in C, array applications - linear search, binary search and bubble sort, two – dimensional arrays, multidimensional arrays.
Strings – Concepts, C Strings, String Input / Output functions, arrays of strings, string manipulation functions.

UNIT 3: (~ 9 Lecture Hours)
Functions - Designing Structured Programs, Functions, user defined functions, inter function communication, Standard functions, Scope, Storage classes - auto, register, static, extern, scope rules, type qualifiers, recursion - recursive functions, Limitations of recursion.
Pointers – Introduction (Basic Concepts), Pointers for inter function communication, pointers to pointers, compatibility, Pointer Applications-Arrays and Pointers, Pointer Arithmetic and arrays, Passing an array to a function, memory allocation functions, array of pointers, programming applications, pointers to void, pointers to functions.

UNIT 4: (~ 10 Lecture Hours)
Enumerated, Structure and Union Types – The Type Definition (typedef), Enumerated types, Structures – Declaration, initialization, accessing structures, operations on structures, Complex structures - Nested structures, structures containing arrays, structures containing pointers, arrays of structures, structures and functions, Passing structures through pointers, self-referential structures, unions, bit fields.

UNIT 5: (~ 7 Lecture Hours)
Introduction to files, Using files in C, Reading data from files- fscanf(), fgets(), fgetc(), fread(), Writing Data to files - fprintf(), fputs(), fputc(), fwrite(), Detecting the End-of-File, Error Handling functions, Random access to files, Command Line Arguments, preprocessor commands.

Text Books:

1. B.A.Forouzan and R.F.Gilberg,Computer Science: A Structured Programming Approach Using C, 3rd Edition, Cengage learning.
2. Reema Thareja, Introduction to C Programming, 2nd Edition, Oxford University Press.

Reference Books:

1. Byron Gottfried, Schaum's Outline of Programming with C, 2nd Edition, McGraw-Hill.
2. E.Balaguruswamy, Programming in ANSI C, 7th Edition, Tata McGraw-Hill.
3. C Programming Language, B.W.Kernighan & Dennis Ritchie, 2nd Edition, PHI.

Online Resources:

1. www.geeksforgeeks.org

Course Outcomes:

After completion of the course, students will be able to

1. Formulate and translate algorithms for arithmetic and logical problems to programs (in C language).
2. Test and execute the programs and correct syntax and logical errors.
3. Implement conditional branching, iteration and recursion.
4. Decompose a problem into functions and synthesize a complete program.
5. Use arrays, pointers and structures to formulate programs.
6. Understand the concepts of files and perform operations on them.

I Year B.Tech. CSE (AI&ML) I-Semester **L T P C**
Course Code: BS12101 **- - 2 1**

CHEMISTRY LAB
(Common to CSM & CSD)

Prerequisites: -Nil-

Course Objectives:
1. Chemistry Laboratory curriculum gives the students hands on experience about various scientific and technical aspects.
2. Provide the students with a solid foundation in Chemistry laboratory required to solve engineering problems.
3. To provide an overview of preparation of drugs.

LIST OF EXPERIMENTS:
Volumetric Analysis:
1. Estimation of hardness of water by Complexometric method using EDTA.
2. Estimation of Ferrous ion by Permanganometry.
3. Estimation of Ferrous ion by Dichrometry.
4. Estimation of Chloride by Argentometry.

Chemical kinetics:
5. Determination of rate constant of acid catalysed hydrolysis of methyl acetate.

Instrumental methods of Analysis:
6. Estimation of HCl by Conductometry.
7. Estimation of HCl and acetic acid in a given mixture by Conductometry.
8. Estimation of HCl by Potentiometry.
9. Estimation of Ferrous by Potentiometry using Potassium dichromate (redox).
10. Estimation of manganese in $KMnO_4$ by Colorimetry.
11. Determination of Viscosity of coconut oil and castor oil.

Synthesis of Drug molecule:
12. Preparation of Aspirin and Paracetamol.

Text Books:
1. B.D.Khosla, A.Gulati and V. Garg, Senior practical physical chemistry (R.C,and and Co., Delhi).
2. K.K.Sharma and D.S.Sharma, An introduction to practical chemistry (Vikaspublishing,N.Delhi).
3. Y.Bharathikumari and JyotsnaCherukuri, Laboratory manual of engineering chemistry (VGS booklinks).

Reference Books:
1. Vogel's Text book of Quantitative chemical analysis, 5th Edition, 2015.
2. Payal B. Joshi, Experiments in Engineering chemistry, 1st Edition, I.K International Publishing house.

Online Resources:
1. http://www.nptel videos.in engineering chemistry labexperiments.htm

Course Outcomes:

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

1. Expected to learn from this laboratory course the concept of error and its analysis.
2. Demonstrate writing skills and can derive valid conclusions.
3. Compare the experimental results with those introduced in lecture, draw relevant conclusions and substantiate.
4. Learn the ability to prepare advanced polymer materials.
5. Work on time reactions, thereby can get in depth knowledge on chemical kinetics.
6. The course allows the students to develop and design new experimental skills relevant to the course.

I Year B.Tech. CSE (AI&ML) I-Semester **L T P C**
Course Code: ES12103 **- - 3 1.5**

BASIC ELECTRICAL ENGINEERING LAB

(Common to CSM & CSD)

Prerequisites: -Nil-

Course Objectives:

1. To verify the Network Theorems and understand the usage of common electrical measuring instruments.
2. To understand the basic characteristics of transformers and electrical machines.
3. To get an exposure to the working of power electronic converters.

PART-A (Compulsory)

1. A) Basic Safety Precautions.
   B) Study of measuring instruments & elements.

a) Voltmeters, Ammeters, Wattmeters, Multimeters, CRO.
b) Resistors, Inductors & Capacitors.

2. Study of Cut – out sections of
   a) DC Machine b) 3-Ø Induction Machine (cage type).
3. Study of Cut – out sections of
   c) Synchronous Machine d) 1-Ø Induction Machine.
4. A) Study of Converters
   a) DC – DC converters.
   b) DC – AC converters.
   B) Study of Components of LT switchgear
   a) SFU b) MCB c) ELCB d) MCCB
5. Series resonance. Determination of Resonant frequency & Bandwidth.
6. Parallel resonance. Determination of Resonant frequency & Bandwidth.
7. Verification of Superposition theorem with DC excitation.
8. Verification of Thevenin's & Norton's theorems with DC excitation.

PART-B (Any Two)

1. Load test on a 1-Ø transformer. Determination of efficiency.
2. Verification of voltage and current relations in a 3-Ø transformer.
3. Measurement of Power in a 3-Ø balanced load.
4. Torque v/s speed characteristics of a separately excited DC motor.
5. Torque-slip characteristics of a 3-Ø Induction Motor.
6. OCC characteristics of a synchronous generator.

Note: All Experiments from PART-A and any Two Experiments from Part –B are to be conducted

Course Outcomes:

After completion of this course, students will be able to

1. Identify & use basic measuring instruments and their usage.
2. Verify different network theorems with dc excitation.
3. Carry out analysis of simple circuits with dc excitation.
4. Analyze bridge rectifiers.
5. Identify power converters.
6. Identify different electrical machines & their characteristics.

I Year B.Tech. CSE (AI&ML) I-Semester **L T P C**
Course Code: ES12105 **- - 3 1.5**

PROGRAMMING LAB

(Common to CST, CSM & CSD)

Prerequisites: -Nil-

Course Objectives:
1. Learn Basic programming concepts.
2. Learn the syntax and semantics of C programming Language.
3. Write programs in C using structured programming approach to solve the problems.

List of Experiments:

Week 1: Familiarization with programming environment.
Introduction to the working environment, Compiling, running and debugging C Programs, Simple C programs.

Week 2: Simple computational problems using arithmetic expressions
a. Write a C program which reads time required (in Hours and Minutes) to complete two tasks and then print the total time in hours and minutes.
b. Write a C program which reads five students marks in a test and then prints average mark of passed students (Assume that a minimum of 35 is needed to pass) using operators.
c. Assume an Object is thrown upwards with some initial velocity, u (in m/sec). Write a C program to find the maximum height which it can reach. Assume acceleration due to gravity is $9.8m^2$ /sec.
Hint: Maximum height, $h=u^2/2g$.

Week 3: Problems involving if-then-else structures and switch statement
a. Write a C program to check whether a given number is even or odd using bitwise operator.
b. Write a C program to find the roots of a quadratic equation.
c. Write a C program to carry out the arithmetic operations addition, subtraction, multiplication, division and modulus using switch statement.

Week 4: Iterative problems
a. Write a C program to find whether a given number is Armstrong or not.
b. Write a C program to determine if the given number is a prime number or not.
c. Write a C program to calculate the following Series:
$Sum=1-x^2/2! +x^4/4!-x^6/6!+x^8/8!-x^{10}/10!$
d. Write a C program to find the number of even and odd digits in a given number.

Week 5: Applications of 1D Array
a. Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user using Sieve of Eratosthenes algorithm.
b. Write a C program to search for a Key value in a given list of integers. Use linear search.
c. Write a C program to search for a Key value in a given list of integers. Use binary search.
d. Write a C program to implement Bubble sort method to sort a given list of integers in ascending order.

Week 6: Applications of Strings
a. Write a C program to perform the following:
i) To insert a sub-string into a main string at a given position.
ii) To delete n characters from a given position in a string.
b. Write a C program to determine whether the given string is a palindrome or not.

c. Write a C program to replace a substring with another in a given line of text.

Week 7: Applications of 2D arrays and Strings

a. Write a C program that reads two matrices and performs Addition of two matrices.
b. Write a C program that reads two matrices and performs Multiplication of two matrices.
c. Write a C program to Sort Array of Strings.

Week 8: Simple functions

a. The least common multiple (LCM) of two positive integers a and b is the smallest integer that is evenly divisible by both a and b. Write a C program that reads two integers and calls LCM (a, b) function that takes two integer arguments and returns their LCM. The LCM (a, b) function should calculate the least common multiple by calling the GCD (a, b) function and using the following relation: LCM (a, b) = ab / GCD (a, b).
b. Write a function to find the factorial of a positive integer.
c. Write a menu-driven C program that allows a user to enter n numbers and then choose between finding the smallest, largest, sum or average. Use a switch statement to determine what action to take. Display an error message if an invalid choice is entered.
d. Write a C program that reads two integers and calls a factorial function to compute ${}^{n}C_{r}$ value.

Week 9: Recursive functions

a. Write a C program that reads two integers x and n and calls a recursive function to compute x^n.
b. Write a C program that uses a recursive function to solve the Towers of Hanoi problem.
c. Write a C program that uses a recursive function to generate Pascal's triangle.
d. A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program which calls a recursive function to generate the first n terms of the sequence.

Week 10: Pointers and dynamic memory allocation

a. Write a C program to find the number of times a given word (i.e., a short string) occurs in a sentence.(i.e., a long string).
b. Using pointers, write a function that receives a character string and a character as argument and deletes all occurrences of this character in the string. Function should return the corrected string with no spaces.
c. Write a C program to find the maximum from a set of elements. The number of elements will be decided during the execution of the program.

Week 11: Structures

a. Write a menu-based program in C that uses a set of functions to perform the following Operations:
   i) Reading a Complex number ii) Writing a complex number
   iii)Addition of two complex numbers iv)Subtraction of two complex numbers
   v) Multiplication of two complex numbers
   Represent the complex number using a structure.
b. Declare a structure to store the following information of an employee: Employee code, Employee name, Salary, Department number, Date of joining (it is itself a structure consisting of day, month and year). Write a C program to store the data of N employees where N is given by the user (Use dynamic memory allocation). Include a Menu that allows user to select any of the following features:

i) Use a function to display the employee information who are drawing the maximum and minimum salary.
ii) Use a function to display the employee records in ascending order according to their date of joining.

Week 12:

a. Write a C program to display the contents of a file to standard output device.
b. Write a C program which copies one file to another, replacing all lowercase characters with their uppercase equivalents.
c. Write a C program to count the number of times a character occurs in a text file. The file name and the character are supplied as command-line arguments.
d. Write a C program to reverse the first n characters in a file. The file name and n are specified on the command line. Use fseek function.

Text Books:

1. B.A.Forouzan and R.F.Gilberg, Computer Science: A Structured Programming Approach Using C, 3rd Edition, Cengage learning.

Reference Books:

1. Byron Gottfried, Schaum's Outline of Programming with C, 2nd Edition, McGraw-Hill.
2. Yashavant P. Kanetkar, Let Us C, 13th Edition, Bpb Publications.
3. B.W.Kernighan& Dennis Ritchie, C Programming Language, 2nd Edition, PHI.
4. E.Balaguruswamy, Programming in ANSI C, 7th Edition, Tata McGraw-Hill.

Online Resources:

1. www.geeksforgeeks.org

Course Outcomes:

After completion of the course, students will be able to

1. Compile, debug and test the program.
2. Apply the knowledge in C to write modular, structured programs in solving real world problems.
3. Design programs to solve mathematical and scientific problems.
4. Write structured programs using control structures and functions.
5. Demonstrate usage of pointers and structures.
6. Solve problems using file concepts.

I Year B.Tech. CSE (AI&ML) II-Semester **L T P C**
Course Code: BS122AC **3 1 - 4**

PHYSICS

(Common to CSM & CSD)

Prerequisites: -Nil-

Course Objectives:

1. To understand the interaction of light with matter through interference and diffraction.
2. To understand the behavior of a particle quantum mechanically.
3. To understand the importance of dielectric and magnetic materials.
4. To analyze the semiconductors and semiconductor devices.
5. To understand the construction and working principle of different types of lasers and light propagation through optical fiber.

UNIT 1: (~ 8 Lecture Hours)
Wave optics: Huygens' Principle, superposition of waves, Interference of light by division of wavefront and amplitude. Young's double slit experiment, Interference from a thin plane glass plate (reflected light), Newton's rings experiment. Types of diffraction, Farunhofer diffraction due to single slit and 'N' slits; Diffraction grating experiment.

UNIT 2: (~ 10 Lecture Hours)
Principles of Quantum mechanics and Band theory of solids: Introduction to Quantum mechanics, Wave particle duality and de-Broglie hypothesis, Davission–Germer experiment; Uncertainty principle, Time-dependent and time independent Schrodinger equation for wave function, Born interpretation; Free-particle wave function, Particle in 1D box (square well potential) energy values, Expectation values vs position in the box.

Density of states and occupation probability; Kronig-Penny model (using Bloch theorem; qualitative), Energy bands in solids, E-k diagram, classification of materials: Metals, Semiconductors and Insulators, Effective mass of an electron.

UNIT 3: (~ 10 Lecture Hours)
Dielectric and magnetic materials : **Dielectric materials**: Electric dipole, Dipole moment, Dielectric constant, Polarizability, Electric susceptibility, Displacement vector, electronic, ionic and orientation polarizations, their polarizabilitity expressions, internal field and Clausius-Mossotti(equations only); Piezoelectricity, pyroelectricity and ferroelectricity and their applications; $BaTiO_3$ structure.
Magnetic materials: Permeability, field intensity, magnetic field induction, magnetization, magnetic susceptibility, origin of magnetic moment, Bohr magneton, classification of dia, para and ferro magnetic materials on the basis of magnetic moment, hysteresis curve based on domain theory, soft and hard magnetic materials, properties of antiferro and ferri magnetic materials,
Superconductivity: Superconductivity phenomenon, Meissner effect, applications of superconductivity.

UNIT 4: (~ 10 Lecture Hours)
Semiconductors: Intrinsic and extrinsic semiconductor carrier concentrations, intrinsic carrier concentration; Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Diffusion and drift phenomenon(Qualitative), Formation of PN junction, open circuit PN junction, energy diagram of PN junction diode, Direct and indirect bandgaps; Hall-effect, Semiconductor materials of interest for optoelectronic devices (LED, Solar cell).

UNIT 5: (~ 10 Lecture Hours)

LASERs and Optical Fibers: **LASERS**: Properties of laser beams: Mono-chromaticity, coherence, directionality and brightness, laser speckles, Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne), solid-state lasers(ruby), Semiconductor Lasers; applications of lasers in science, engineering and medicine.

Fiber Optics: Introduction, light propagation through optical fibre: Total internal reflection, Types of optical fibres: step and graded index fibres, Acceptance angle, Numerical aperture, Attenuation and Bending losses in optical fibres, Applications of optical fibres in Communication, Medicine and as sensors.

Text Books:

1. MN Avadhanulu & PG Kshirsagar, A text book of Engineering Physics, revised Edition of 2014, S Chand.
2. DK Bhattacharya & Poonam Tandon, Engineering Physics, fourth impression 2017, Oxford press.

Reference Books:

1. Eisberg and Resnick, Quantum Physics, 2nd Edition, Wiley.
2. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., (2007).
3. Material Science by Armugam, Anuradha publications.
4. Physics of the atom by Wehr and Richards. 4th Edition, Narosa.

Online Resources:

1. http://www.cod.edu/people/faculty/cartert/phy2112/slides/Lect29-physical-optics-handout.pdf
2. https://www2.physics.ox.ac.uk/sites/default/files/2012-02-17/optics_lectures_2012_pdf_10837.pdf
3. http://www.iap.uni-jena.de/iapmedia/de/Lecture/Physical+optics1501538400/PO16_Physical+optics+8+Lasers.pdf
4. http://alan.ece.gatech.edu/ECE6451/Lectures/ECE6451L1IntroductionToElectronicMaterials.pdf
5. https://www.colorado.edu/physics/phys3330/phys3330_fa11/Lecture%20notes/semiconductor%20lectures%202011.pdf
6. http://www.seklad69associates.com/seklad69associates.com/EEG_811_files/Semiconductor%20Physics.pdf
7. https://www.youtube.com/watch?v=03j4ZvQCKWY

Course Outcomes:

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

1. Realize the importance of light interaction with matter and its effects of superposition.
2. Understand the quantum mechanical behavior of particles in different field environments.
3. Distinguish materials on the basis of their electric and magnetic behavior and their applications.
4. Estimate the carrier concentration of different types of semiconductors and be able to understand the working of optoelectronic devices.
5. Realize the importance of Lasers in engineering fields.
6. Understand the underlying principles of optical fibers and fiber optics.

I Year B.Tech. CSE (AI&ML) II-Semester	**L**	**T**	**P**	**C**
Course Code: BS122AG	**3**	**1**	**-**	**4**

NUMERICAL TECHNIQUES AND TRANSFORM CALCULUS

(Common to CST, CSM & CSD)

Prerequisites: -Nil-

Course Objectives:

1. To learn an alternative method for analytical methods in mathematical concepts.
2. To apply numerical techniques in solving ordinary differential equations.
3. To study the properties of vector valued functions and differential operators.
4. To attain the knowledge on integrals of vector valued functions.

UNIT 1: (∼ 9 Lecture Hours)

Numerical Solutions of Algebraic and Transcendental Equations: Introduction, Bisection Method, Regula-False method, Iteration method and Newton Raphson method. Solving linear system of equations by Gauss-Jacobi and Gauss-Seidel method.

Curve Fitting: Fitting a linear, second degree, exponential curve by method of least squares for the discrete data.

UNIT 2: (∼ 9 Lecture Hours)

Numerical integration: Newton-Cote's Quadrature Formula, Trapezoidal Rule, Simpson's 1/3rd and 3/8th Rule.

Numerical solutions of Ordinary Differential Equations: Solution of ordinary differential equations by Taylor's Series, Picard's method of Successive approximations, Euler's and Modified Euler's methods, Fourth Order Runge-Kutta Method.

UNIT 3: (∼ 10 Lecture Hours)

Laplace Transforms - Laplace Transform of Standard functions, First and Second Shifting Theorems, Transforms of derivatives and integrals, Multiplication and Division by 't', Laplace Transform of Periodic Function, Unit Step function, Dirac's Delta function.

Inverse Laplace Transform- Method of Partial Fractions, Convolution theorem (without proof) Applications of Laplace Transforms to Ordinary Differential Equations.

UNIT 4: (∼ 10 Lecture Hours)

Vector Differentiation- Scalar and Vector point functions, Gradient, Divergence, Curl and related properties, Unit Normal Vector, Directional Derivatives and Angle between the surfaces, Laplacian operator and Vector identities.

UNIT 5: (∼ 10 Lecture Hours)

Vector Integration - Line Integral-Work Done-Potential function, Area, Surface and Volume Integral.

Vector Integral Theorems: Green's theorems, Stoke's theorems and Gauss's divergence theorems (Without Proofs) and their Verification.

Text Books:

1. Dr.B.S Grewal, Higher Engineering Mathematics, 45th Edition, Khanna Publishers.
2. M.K.Jain, S.R.K.Iyengar and R.K.Jain, Numerical Methods for Science and Engineering Computation, 6th Edition, New Age International Publishers.

Reference Books:

1. R K Jain & S R K Iyengar, Advanced Engineering Mathematics, 5th Edition, Narosa Publishers.
2. Murray R Spiegel and Seymour Lipschutz, Vector Analysis, 2nd Edition, Schaums' Outlilne Series.
3. S.S.Sastry, Introductory Methods of Numerical Analysis, 5th Edition, PHI Learning Pvt. Ltd.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc17_ma14/preview
2. nptel.ac.in/courses/117101056/17

Course Outcomes:

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

1. Find the root of the equation and solution of a system of equations.
2. Fit a curve for the given data.
3. Find the Numerical solutions for a given first order initial value problem.
4. Use Laplace Transform techniques for solving ODE's.
5. Verify the irrotational and solenoidal fields and find the potential function.
6. Evaluate the line, surface and volume integrals and converting them from one to another.

I Year B.Tech. CSE (AI&ML) II-Semester **L T P C**
Course Code: HS122AJ **2 - - 2**

ENGLISH

(Common to CST, CSM & CSD)

Prerequisites: -Nil-

Course Objectives:

1. To enable the students to understand the importance of English and to develop their basic proficiency in the English language.
2. To train the students to expand their vocabulary and to understand the usage of vocabulary technically and literally.
3. To develop the reading competence of the students through the sub skills of reading.
4. To equip the students with an ability to produce grammatically correct sentences and coherently well-developed paragraphs.
5. To enable the students to develop an appreciation of how the formal elements of language and genre shape meaning and to gain richer understanding of both the text and the cultural context.

UNIT 1: (~ 7 Lecture Hours)

- **Reading Comprehension**: Short story *Cause, Then Cure* from **Wise and Otherwise** by Sudha Murthy. *Reading Skills*: SQW3R Method and guessing and predicting.
- **Vocabulary Building**: Word formation – Root words – Prefixes and Suffixes – Word formation.
- **Remedial Grammar**: Error correction related to: Subject – Verb Agreement, Noun – Pronoun Agreement, and other aspects that are reflected through their writing.
- **Writing Skills**: Sentence structure – Use of Phrases and Clauses in sentences - Sentence Types: Assertive, Declarative, Interrogative, Exclamatory, sentences and Simple, Compound, Complex and Compound-Complex Sentences - Usage of punctuation marks.

UNIT 2: (~ 7 Lecture Hours)

- **Reading Comprehension:** Poem*Caged Bird* from **A Collection of Hundred Poems** by Maya Angelou. *Reading Skills*: STEM Technique, vocabulary and intended meaning.
- **Vocabulary Building:** Synonyms - Antonyms - Acronyms - Abbreviations
- **Remedial Grammar:** Error Correction related to: Articles and Prepositions, Tenses, Conditional clauses, Tag Questions; and other aspects that are reflected through their writing.
- **Writing Skills:** Principles of Paragraph writing - Cohesive Devices - Creating Coherence - Topic sentence and supporting sentences in a Paragraph - Techniques for writing Precisely - Jumbled sentences.

UNIT 3: (~ 6 Lecture Hours)

- **Reading Comprehension:** General Reading versus Academic Reading
  *Reading Skills***:** Reading for gist, main ideas, specific details.
- **Vocabulary Building**: Homophones - Homonyms –Homographs - Words often confused.
- **Remedial Grammar**: Error correction related to: Adjectives and Adverbials, Misplaced modifiers, Redundancies; and other aspects that are reflected through their writing.
- **Writing skills**: Precis writing and Summarizing.

UNIT 4: (~ 6 Lecture Hours)

- **Reading Comprehension:** Excerpt from **Wings of Fire: An Autobiography** *Looking Ahead* from APJ Abdul Kalam with Arun Tiwari *Abridged version.*
  Reading Skills: Reading for inference, discourse markers, contextualization, summarizing.
- **Vocabulary Building:** Phrasal verbs – collocations – Idioms.
- **Remedial Grammar**: Error corrections related to: Adverbs and Adjectives, Syntactical errors and punctuation marks; and other aspects that are reflected through their writing.
- **Writing Skills**: Letter Writing – Introducing oneself – Statement of Intent – Asking for direction – Seeking / giving information – Apologizing.

UNIT 5: (~ 6 Lecture Hours)

- **Reading Comprehension**: Travelogue *The Pamplona Clone: Jallikattu*from **Intriguing India – The Historic South** by Hugh and Colleen Gantzer.
  Reading Skills: Understanding the organization of text, global comprehension.
- **Vocabulary Building:** One-word substitute - General vocabulary versus Academic vocabulary - Literal meaning versus contextual meaning.
- **Remedial Grammar:** Sentence corrections and Editing and proof reading; and other aspects that are reflected through their writing.
- **Writing Skills**: Letter of Application: Covering letter and Resume Writing.

Note: The content prescribed for Reading Comprehension is for Reading Practice only and shall not be given for assessment and evaluation. An unknown Reading Passage shall be given for assessment and evaluation to test the Reading Skills.

Text Books:

1. Vibrant English by Orient Blackswan, 2013.
2. Language and Life: A Skills Approach by Orient Black Swan, 2018.

Reference Books:

1. Sudha Murthy, *Wise & Otherwise – A Salute to Life* Penguin Books, 2006.
2. Hugh and Colleen Gantzer, *Intriguing India – The Historic South* NIYOGI Books, (2012).
3. Collection of Poems //www.poetryfoundation.org//
4. Mukul Chowdhry, Simplified and abridged *Wings of Fire: An Autobiography*, *APJ Abdul Kalam with Arun Tiwari* University Press Pvt. Ltd. (2004).

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc16_hs01
2. https://nptel.ac.in/courses/109106094/5

Course Outcomes:

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

1. Read complex texts actively comprehending the literal and figurative use of language and be able to read in-between the line.
2. Write grammatically correct sentences and coherently well- developed paragraphs.
3. Apply the reading techniques and comprehend the passages critically.
4. Use appropriate vocabulary in the given context.
5. Appreciate how different genres use language and shape meanings.
6. Articulate clear questions, to provoke critical thinking, and ideas in class discussion to speak confidently in public.

I Year B.Tech. CSE (AI&ML) II-Semester **L T P C**
Course Code: ES122AE **1 - 3 2.5**

ENGINEERING GRAPHICS

(Common to CSM & CSD)

Prerequisites: -Nil-

Course Objectives:

The course will enable the students

1. To impart skills of drawing instruments and their use to convey exact and complete information of any object.
2. To construct conics and cycloidal curves used for various engineering applications.
3. To impart knowledge about standard principles of orthographic projection of objects.
4. To develop different surfaces of simple solids.
5. To differentiate between isometric view and projection and conversion of isometric views to orthographic views vice-versa.

UNIT 1: (~ 4 Lecture Hours and 12 Practical Hours)
Introduction to Engineering Graphics: Principles of Engineering Graphics and their significance, Conic Sections-general and special methods, Cycloid, Epi- cycloid and Hypo- Cycloid.

UNIT 2: (~ 3 Lecture Hours and 9 Practical Hours)
Orthographic Projections: Principles of Orthographic Projections – Conventions - Projections of points, straight lines and planes.

UNIT 3: (~ 3 Lecture Hours and 9 Practical Hours)
Projection of Solids: Projections of solids in simple position (prisms, pyramids, cylinders and cone), axis inclined to one plane, Axis inclined to both the reference planes, Projection of solids using auxiliary plane method.

UNIT 4: (~ 3 Lecture Hours and 9 Practical Hours)
Development of Surfaces: Basic concepts of development of surfaces, Methods of development – Parallel line development and radial line development, Development of prisms, pyramids, Cylinders and cones.

UNIT 5: (~ 3 Lecture Hours and 9 Practical Hours)
Isometric & Orthographic Projections: Principles of Isometric Projection – Isometric Scale – Isometric Views – Conventions – Isometric views of Lines, Plane figures, Simple Solids – Conversion of Isometric Views to Orthographic Views.

Text Books:

1. Basanth Agrawal, Agrawal C.M., Engineering Graphics, First Edition, Tata McGraw Hill, 2012.
2. Bhatt N.D., Elementary Engineering Drawing, 2014, Charotar Publishers.

Reference Books:

1. K .L. Narayana and P.Kannaiah, Engineering Drawing, Scitech, 2010.
2. Venugopal.K, Engineering Drawing and Graphics Plus Autocad, New Age International (P) Ltd., New Delhi, 2010.
3. Gill P.S., Engineering Drawing: Geometrical Drawing, SK Kataria & sons, 2012.
4. Dhananjay A Jolhe, Engineering Drawing, Tata McGraw Hill, 2014.

Online Resources:

1. www.engineeringdrawing.org
2. Virtual labs (www.vlab.co.in)

Course Outcomes:

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

1. Know and understand the conventions and methods of Engineering Graphics.
2. Construct the conics using different methods and cycloidal curves.
3. Draw and understand about orthographic projections of points, straight lines and planes.
4. Improve visualisation skills in different types of solids.
5. Draw and understand about the development of surfaces of various solids.
6. Ability to read, understand and interpret engineering drawings.

I Year B.Tech. CSE (AI&ML) II-Semester **L T P C**
Course Code: BS12208 **- - 3 1.5**

PHYSICS LAB

(Common to CSM & CSD)

Prerequisites: -Nil-

Course Objectives:

1. Students are introduced to handling different instruments to conduct experiments as well as to interpret the data.
2. Students are introduced to experiments as to interpret the data and correlate the same with their understanding of its theory.
3. The objective of the course is to enable students to design experiments and analyses the concepts.

LIST OF EXPERIMENTS:

1. Dispersive power of the material of a prism – Spectrometer.
2. Determination of wavelengths of white source – Diffraction grating.
3. Newton's Rings – Radius of curvature of Plano convex lens.
4. Melde's experiment – Transverse and longitudinal modes.
5. Time constant of an R-C circuit (Charging and Discharging).
6. L-C-R circuit. – Resonance & Q-factor (series / Parallel).
7. Magnetic field along the axis of current carrying coil – Stewart and Gees method and to verify Biot – Savart's law.
8. Evaluation of numerical aperture of a given optical fiber.
9. Bending and attenuation losses of fibers.
10. Energy gap of a material of p-n junction.
11. Torsional pendulum – Rigidity modulus.
12. Wavelength of light and determining the LPI of unknown grating of a diffraction grating using laser.
13. V-I characteristics of a solar cell.
14. Quantum dots (Beyond syllabus).

Note: Minimum 12 experiments must be performed.

Text Books:

Manual as prepared for the college by the faculty.

Online Resources:

1. http://www.bsauniv.ac.in/UploadImages/Downloads/PHYSICS-LAB-MANUAL2017-(new-regulation).pdf
2. http://jnec.org/Lab-manuals/FE/Physics.pdf
3. https://www.myphysicslab.com/ (simple simulations)
4. https://www.iist.ac.in/departments/physics-lab
5. https://wci.llnl.gov/simulation

Course Outcomes:

After completion of the course, students will be able to

1. Handle different measuring instruments and asses their accuracy of measurement.
2. Experiment and analyze the results to derive valid conclusions.
3. Compare the experimental results with those introduced in lecture, draw relevant conclusions and substantiate.
4. Develop the experimental skills to design new experiments in engineering.
5. Understand the ethics of working environment and deliver the results in time.
6. Engage themselves in team work and understand each other's strengths.

I Year B.Tech. CSE (AI&ML) II-Semester **L T P C**
Course Code: HS12212 **- - 2 1**

ENGLISH PROFESSIONAL AND COMMUNICATION SKILLS LAB
(Common to CST, CSM & CSD)

Prerequisites: -Nil-

Course Objectives:
1. To introduce the students to the pronunciation symbols and associated sounds of English.
2. To enable the students understand the concept of syllable, word accent and intonation.
3. To enhance the listening skills to understand the nuances of accent, expression, tone and intended meaning to make them understand the difference between stress timed language and syllable timed language.
4. To help the students overcome their inhibitions while speaking English fluently thereby to build their confidence to express their ideas in English.
5. To help the students understand the importance of inter-personal communication, team dynamics and role behavior at the work place.

List of Activities:
Multimedia Lab:
1. **Introduction to the Phonetic symbols and associated sounds of English:** Vowels – Consonants – Diphthongs. *Extensive practice through referring to a dictionary.*
2. **Word Accent and Pronunciation:** Defining Syllable – Marking Word Accent – Rules of Word Accent - Accent shift versus Suffixes. *Extensive practice through List of words, Homographs, Silent letters.*
3. **Intonation:** Introduction to Stress and Rhythm - Tonal groups – weak forms Tone versus context – Falling Tone, Rising Tone, Fall and Rise in Tone. *Extensive Practice through listening to different genres – Speech, Poetry, Story, Conversations, Discussions, Talks.*
4. **Vocabulary Building:** Practice exercises in vocabulary through word bank and corpus list.
5. **Listening skills:** Focused Listening **-** Listening to understand main ideas and specific information and to recognize the opinions, attitudes and purpose of a speaker.

Communication Skills Lab:
1. **Situational Dialogues/ Role Plays:** Formal – Semiformal – informal situations – Punctuation Marks – Tonal variations and voice modulations. *Practice in two-way conversations, Discussions, Talks and Interviews.*
2. **Communication skills at workplace:** Task based activities for: Intra-personal and Inter-personal communications – Types of communications: oral, written and non-verbal - Group dynamics.
3. **Oral Presentations:** Prepared and Extempore **-** Poster Presentations and JAM [Just A Minute] - Choosing a topic – Developing the content – Choosing appropriate vocabulary - Coherence in presentation – Audibility.
4. **Mini Project** – ***In campus Survey Report:*** Project selection – Team size – Preparing a questionnaire – data collection – data analysis – conclusions and recommendations – Report submission in Manuscript format.
5. **Group Discussions:** Definition of GD – Importance of GD – Stages of GD – Etiquette, Communications, Content, Approach during GD – Individual Roles – Group goals - Types of GD - Expectations and outcomes.

Reference Books:
1. J.Sethi, Kamlesh Sadanand & DV Jindal A Practical Course in English Pronunciation (with two Audio Cassettes) Prentice-Hall of India Pvt.Ltd., New Delhi.

2. T.Balasubramanian, A text book of English Phonetics for Indian Students Macmillan Publications.
3. RK.Bansal and JB.Harrison, Spoken English Orient Longman, 2006.
4. Krishna Mohan & NP Singh, Speaking English Effectively Macmillan Publications.
5. Business English Communication – Preliminary Cambridge University Press.

Course Outcomes:

After learning the contents of this course, the students will be able to

1. Differentiate between the letters of alphabet and the phonetic symbols.
2. Demonstrate the right pronunciation of the words in English using phonetic transcription and word stress.
3. Speak with the proper intonation, voice modulation and tonal groups.
4. Demonstrate the listening skills through language modules.
5. Speak with clarity and confidence individually and in groups to discuss and present the topics chosen and understand the nuances of team dynamics.
6. Work individually and in teams present the topics and demonstrate their public speaking skills and presentation skills through various aids like posters, PPTs etc.,

I Year B.Tech. CSE (AI&ML) II-Semester **L T P C**
Course Code: ES12210 **- - 3 1.5**

COMPUTATIONAL MATHEMATICS LAB

(Common to CST, CSM & CSD)

Prerequisites: Programming for Problem Solving.

Course Objectives:

1. To illustrate the Flow chart and design an algorithm for the given method.
2. To develop conditional and iterative statements to solve system of linear equations using C language.
3. To inscribe C program that use pointers and functions to find the root of given equation.
4. To implement loops, arrays and strings to solve differential equations in C language.

List of Experiments:

1. Write a C Program to find the addition, subtraction, multiplication of matrices.
2. Write a C Program to find the root of a given equation using Bisection method**.**
3. Write a C Program to find the root of a given equation using method of False position.
4. Write a C Program to find the root of a given equation using Iteration method.
5. Write a C Program to find the root of a given equation using Newton Raphson method.
6. Write a C Program to solve a given system of linear equations using Jacobi's method.
7. Write a C Program to solve a given system of linear equations using Gauss Seidel iteration method.
8. Write a C Program to evaluate definite integral using Trapezoidal rule, Simpson's 1/3rd rule and 3/8th rule.
9. Write a C Program to solve a given differential equation using Taylor's series.
10. Write a C Program to solve a given differential equation using Picard's method.
11. Write a C Program to solve a given differential equation using Euler's method.
12. Write a C Program to solve a given differential equation using Runge-Kutta method.

Text Books:

1. M.K.Jain, S.R.K.Iyengar, and R.K.Jain, Numerical Methods for Scientific and Engineering Computation, 6th Edition, New Age International Publishers.
2. E Balagurusamy, C Programming and Data Structures, 4th Edition, Tata McGraw-Hill Publications.

Reference Books:

1. Pradip Niyogi, Numerical Analysis and Algorithms, 5th Edition, Tata McGraw-Hill Publishers.
2. Yashavant Kanetkar, Let us C-C Programming, 3rd Edition, Schaums' outline series.

Online Resources:

1. http://nptel.ac.in/noc/individual_course.php?id=noc15-cs05
2. http://www.codingalpha.com/numerical-methods-c-program/

Course Outcomes:

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

1. Write Flow chart and algorithm for the given program.
2. Have the ability to write C programs to solve specified problems.
3. Find the root of a given equation using C program.

4. Use arrays as part of the software solution.
5. Utilize pointers to efficiently solve problems.
6. Use functions from the portable C library.

I Year B.Tech. CSE (AI&ML) II-Semester **L T P C**
Course Code: ES12211 **1 - 3 2.5**

ENGINEERING WORKSHOP

(Common to CSM & CSD)

Prerequisites: -Nil-

Course Objectives:

The course will enable the students

1. To study of different hand operated Power Tools, uses and their demonstration.
2. To gain a good basic working knowledge required for the production of various engineering products.
3. To provide hands on experience about use of different engineering materials, tools, equipments and processes those are common in the Engineering field.
4. To develop a right attitude, team working, precision and safety at work place.
5. To study commonly used carpentry joints.
6. To have practical exposure to various welding and joining processes.

I) Trades for Exercises: (~ 12 Lecture Hours and 36 Practices)

At least two exercises from each trade:

i) Carpentry
ii) Fitting
iii) Tin-Smithy and Development of jobs carried out and Soldering
iv) House-wiring
v) Foundry
vi) Black smithy

II) Trades for Demonstration and Exposure: (~ 12 Lecture Hours)

i) Plumbing
ii) Machine Shop
iii) Wood Turning
iv) Welding

Text Books:

1. B.L. Juneja, Workshop Practice, Cengage publications.
2. K. Venugopal, Workshop Manual, Anuradha Publications.

Reference Books:

1. P. Kannaiah & K. L. Narayana, Workshop manual, 2nd Edition, Scitech publications (I) Pvt. Ltd., Hyderabad.
2. K. Venugopal, Dr. V. Prabhu Raja, G. Sreekanjana “Workshop Manual” 1st Edition, Anuradha Publications, 2012.
3. Hajra Choudury S.K., Hajra CHoudury A.K. and Nirjhar Roy S.K., Elements of Workshop technology, volI 2008 and Vol II 2010, Media Promoters and Publishers private limited, Mumbai.

Online Resources:

1. www.technologystudent.com

Course Outcomes:

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

1. Demonstrate and understand the Engineering workshop safety regulations.
2. Identify and use marking tools, measuring equipment and to work to prescribed accuracies.
3. Know various operations in basic engineering workshops.
4. Understand the practical difficulties encountered in industries during any assembly work.
5. Do simple electrical work through their carrier.
6. Design different prototype in the fittings, carpentry, foundry, black smithy and sheet metal work.

II Year B.Tech. CSE (AI&ML) I-Semester	**L**	**T**	**P**	**C**
Course Code: BS123AL	**3**	**-**	**-**	**3**

PROBABILITY AND STATISTICS

(Common to CST & CSM)

Prerequisites: -Nil-

Course Objectives:

1. To learn the random variables and theoretical probability distributions.
2. To study the sampling distribution of mean and testing of hypothesis.
3. To learn the concept of confidence interval for proportions and small sample tests.
4. To check and determine the relation between two variables/attributes.

UNIT 1: (~10 Lecture Hours)
Random Variables: Introduction to random variables, Discrete random variable, Continuous random variable, Probability distributions and cumulative distribution functions, properties, Mathematical expectation.

UNIT 2: (~10 Lecture Hours)
Probability Distributions: Binomial distribution, Poisson distribution, Normal distribution, Sampling Distribution of means. (σ Known and unknown).

UNIT 3: (~12 Lecture Hours)
Theory of Estimation: Point estimation, Interval estimation, Confidence interval for mean.
Inference Theory (Large Samples): Null hypothesis, Alternate hypothesis, Type I and Type II errors, Critical region, Test of significance for single mean, Test of significance for difference of means.

UNIT 4: (~10 Lecture Hours)
Testing of Hypothesis: Confidence interval for proportions, Test of significance for single and difference of proportions.
Small sample tests: t, F and Chi-Square distributions.

UNIT 5: (~6 Lecture Hours)
Correlation and Regression: Coefficient of correlation, Rank correlation, Regression coefficient, Lines of regression, multiple correlation and regression.

Text Books:

1. S.C.Gupta and V.K.Kapoor, Fundamentals of Mathematical Statistics, 11th Edition, Sultan Chand & Sons.
2. Vijay K Rohatgi, Statistical Inference, Aug 2003, Dover Publications Inc.

Reference Books:

1. S.P.Gupta, Statistical Methods, 33rd Edition, Sultan Chand & Sons.

2. M.K.Jain, S.R.K.Iyengar and R.K.Jain, Numerical Methods for Science and Engineering Computation, 6th Edition, New Age International Publishers.
3. Miller and John E Freund, Probability and Statistics for Engineers, 5th Edition.

Online Resources:

1. http://nptel.ac.in/courses/111105090/
2. http://nptel.ac.in/courses/111106112/

Course Outcomes:

After completion of the course, students will be able to

1. Differentiate among the random variables involved in the probability models which are useful for all branches of engineering.
2. Understand probability distributions such as Binomial, Poisson and Normal distributions.
3. Analyze data and draw conclusion about collection of data under study using theory of estimation.
4. Apply testing of hypothesis for large samples.
5. Apply testing of hypothesis for small samples.
6. Estimate and establish relation between variables using correlation and regression analysis.

II Year B.Tech. CSE (AI&ML) I-Semester **L T P C**
Course Code: BS123AZ **3 - - 3**

DISCRETE MATHEMATICS
(Common to CST & CSM)

Prerequisites: -Nil-

Course Objectives:
1. Introduce the concepts of mathematical logic.
2. Gain knowledge in sets, relations and functions.
3. Solve problems using counting techniques and combinatorics.
4. Introduce generating functions and recurrence relations.
5. Use Graph Theory for solving real world problems.

UNIT 1: (~ 10 Lecture Hours)
Mathematical Logic: Introduction, Statements and Notation, Connectives, Well-formed formulas, Tautology, Duality law, Equivalence, Implication, Normal Forms, Functionally complete set of connectives, Inference Theory of Statement Calculus, Predicate Calculus, Inference theory of Predicate Calculus.

UNIT 2: (~ 10 Lecture Hours)
Set theory: Basic Concepts of Set Theory, Relations and Ordering, Functions-composition of functions, Inverse Functions, Recursive Functions, Lattices and its properties.
Algebraic structures: Algebraic systems-Examples and General Properties, Semi groups and Monoids, groups, sub groups, homomorphism, Isomorphism.

UNIT 3: (~ 9 Lecture Hours)
Elementary Combinatorics: Basics of Counting, Combinations and Permutations, Enumeration of Combinations and Permutations, Enumerating Combinations and Permutations with Repetitions, Enumerating Permutations with Constrained Repetitions, Binomial Coefficients, The Binomial and Multinomial Theorems, The Principle of Inclusion- Exclusion, Pigeon hole principle and its application.

UNIT 4: (~ 8 Lecture Hours)
Recurrence Relations: Generating Functions of Sequences, Calculating Coefficients of Generating Functions, Recurrence relations, Solving Recurrence Relations by Substitution and Generating functions, The Method of Characteristic roots, Solutions of Inhomogeneous Recurrence Relations.

UNIT 5: (~ 8 Lecture Hours)
Graphs: Basic Concepts, Isomorphism and Subgraphs, Trees and their Properties, Spanning Trees, Directed Trees, Binary Trees, Planar Graphs, Euler's Formula, Multigraphs and Euler Circuits, Hamiltonian Graphs, Chromatic Numbers, The Four Color Problem.

Text Books:
1. Joe L. Mott, Abraham Kandel and Theodore P. Baker, Discrete Mathematics for Computer Scientists & Mathematicians, 2nd Edition, Pearson Education.
2. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw Hill, 2002.

Reference Books:

1. Kenneth H. Rosen, Discrete Mathematics and its Applications with Combinatorics and Graph Theory, 7th Edition, McGraw Hill Education (India) Private Limited.
2. D.S. Malik and M.K. Sen, Discrete Mathematics, Theory and Applications, Revised Edition, Cengage Learning.
3. C. L. Liu and D. P. Mohapatra, Elements of Discrete Mathematics, A Computer Oriented Approach, 4th Edition, McGraw Hill education (India) Private Limited.
4. Thomas Koshy, Discrete Mathematics with Applications, Elsevier Academic Press, 2012.

Online Resources:

http://www.cs.yale.edu/homes/aspnes/classes/202/notes.pdf

Course Outcomes:

After completion of the course, students will be able to

1. Apply mathematical logic to solve problems.
2. Understand the concepts and perform the operations related to sets, relations and functions.
3. Gain the conceptual background needed and identify structures of algebraic nature.
4. Apply basic counting techniques to solve combinatorial problems.
5. Formulate problems and solve recurrence relations.
6. Apply Graph Theory in solving computer science problems.

II Year B.Tech. CSE (AI&ML) I-Semester **L T P C**
Course Code: ES123AN **3 - - 3**

DIGITAL LOGIC DESIGN

(Common to CST, CSM & CSD)

Prerequisites: -Nil-

Course Objectives:

1. Understand basic number systems, codes and logical gates.
2. Know the concepts of Boolean algebra and minimization logic.
3. Learn the design of combinational and sequential circuits.
4. Know the basics of various types of memories.
5. Study the hardware implementation using Programmable Logic Devices.

UNIT 1: (~10 Lecture Hours)
Fundamentals of Digital Design: Digital Systems, Binary Numbers, Number Base Conversions, Octal, Hexadecimal and other Base numbers, Complements, Signed Binary Numbers, Binary Codes, Error Detection and Correction, Binary Logic, Boolean Algebra: Basic theorems and properties of Boolean Algebra, Boolean functions, Digital Logic Gates.

UNIT 2: (~7 Lecture Hours)
Minimization of Logic Functions: Standard representation for logic functions, K-Map representation, Simplifications of logic functions using K-Map, Sum of products , Product of sums simplification, Don't care conditions , NAND and NOR implementations.

UNIT 3: (~10 Lecture Hours)
Combinational Digital Circuits: Combinational Circuits(CC), Design Procedure, Combinational circuit for different code converters and Parity generator/Checker, Binary Adder-Subtractor, Decimal Adder, Binary Multiplier, Magnitude Comparator, Decoders, Encoders, Multiplexers, De-multiplexers, ALU: Micro-operations, Arithmetic Logic Shift Unit.

UNIT 4: (~10 Lecture Hours)
Sequential Circuits and Systems: Synchronous Sequential Circuits, Latches, Flip-flops, Analysis of clocked sequential circuits, Registers, Shift registers, Ripple counters, Synchronous counters, other counters and Applications of counters.
Asynchronous Sequential Circuits -Introduction, Analysis procedure, Circuits with latches, Design procedure.

UNIT 5: (~8 Lecture Hours)
Semiconductor Memories and Programmable Logic Devices: Memory: Introduction, Read-Write Memory (RAM), Read Only Memory (ROM), Memory decoding, Programmable Logic Array, Programmable Array Logic, Sequential programmable devices: SPLD, CPLD, FPGA.

Text Books:

1. M. Morris Mano and M.D.Ciletti, Digital Design, 5th Edition, Pearson.
2. R.P. Jain, Modern Digital Electronics, Tata McGraw Hill Education, 2009.

Reference Books:

1. A. Kumar, Fundamentals of Digital Circuits, Prentice Hall India, 2016.
2. M.Morris Mano, Computer System Architecture, 3rd Edition, Pearson.
3. H. Roth and L. L. Kinney, Fundamentals of Logic Design, 7th Edition, Cengage Learning.
4. M. Rafiquzzaman, Fundamentals of Digital Logic & Micro Computer Design, 5th Edition, John Wiley.

Online Resources:

1. www.tutorialspoint.com/digital_circuits/index.htm
2. https://onlinecourses.nptel.ac.in

Course Outcomes:

After completion of the course, students will be able to

1. Demonstrate different Number systems, Binary codes and Boolean algebra.
2. Solve Boolean expressions using minimization methods.
3. Understand the concepts of Combinational circuits and design simple applications.
4. Distinguish different types of Sequential circuits.
5. Describe functionality of memory devices.
6. Design Hardware that suits various Micro-Operations.

II Year B.Tech. CSE (AI&ML) I-Semester **L T P C**
Course Code: PC123NA **3 1 - 4**

DATA STRUCTURES USING C
(Common to CSM & CSD)

Prerequisites: Programming for Problem Solving
Course Objectives:

1. Understand the notations used to analyze the performance of algorithms.
2. Understand and analyze various searching and sorting algorithms.
3. Understand the behaviour of data structures such as stacks, queues, trees, hash tables, search trees, graphs and their representations.
4. Choose an appropriate data structure for a specified application.
5. Introduces tries and pattern matching algorithms

UNIT 1: (~8 Lecture Hours)
Basic Concepts: Performance analysis – Time Complexity and Space Complexity, Asymptotic Notation – Big O, Omega and Theta notations, Complexity Analysis Examples.
Searching: Linear Search, Binary Search, Interpolation Search.
Sorting: Insertion Sort, Selection Sort, Quick Sort, Merge Sort, Radix Sort, External Sorting- Model for External Sorting, Comparison of Sorting Methods.

UNIT 2: (~10 Lecture Hours)
Introduction to Data Structures: Linear and Non-linear data structures.
Linear List: Array and Linked Representations, Singly Linked List, Operations – Insertion, Deletion and Searching, Circularly Linked List, Operations – Insertion, Deletion and Searching, Doubly Linked List, Operations– Insertion, Deletion and Searching, Applications of Linked List – Sparse matrix.
Stack: Definition, Array and Linked implementations, Applications– Infix to Postfix Conversion, Postfix Expression Evaluation, Recursion.
Queue: Definition, Array and Linked implementations, Circular Queues–Insertion and Deletion Operations, Double ended Queue.

UNIT 3: (~8 Lecture Hours)
Trees: Definitions, Terminology, Applications, Properties, Binary Tree - Array and Linked representations, Binary Tree Traversals, Threaded Binary Tree.
Priority Queues: Definition and Applications, Max Priority Queue – Implementation, Max Heap - Definition, Insertion and Deletion, Heap Sort.

UNIT 4: (~9 Lecture Hours)
Search Trees: Binary Search Trees, Definition, Implementation, Operations- Searching, Insertion and Deletion.
Balanced Search Trees: AVL Trees, Operations – Insertion, Deletion and Searching, B-Trees, Operations – Insertion, Deletion and Searching, Red–Black Trees.
Graphs: Definitions, Terminology, Applications, Properties, Graph Representations-Adjacency Matrix, Adjacency Lists, Graph Traversal Methods – DFS and BFS

UNIT 5: (~10 Lecture Hours)
Hashing: Introduction, Hash Tables, Hash Functions, Overflow Handling, Extended Hashing.
Dictionaries: Linear List Representation, Hash Table Representations, Operations - Insertion, Deletion and Searching.
Pattern Matching and Tries: Pattern Matching Algorithms-Brute Force, The Boyer – Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries.

Text Books:

1. Fundamentals of Data Structures in C, 2nd Edition, E. Horowitz, S. Sahni and Susan Anderson Freed, Universities Press.
2. Data Structures using C – A. S. Tanenbaum, Y. Langsam and M.J. Augenstein, PHI/Pearson Education.

Reference Books:

1. Data Structures: A Pseudocode Approach with C, 2nd Edition, R. F. Gilberg and B.A. Forouzan, Cengage Learning.
2. Data Structures and Program Design Using C: A Self-Teaching Introduction, D. Malhotra, N. Malhotra, Mercury Learning and Information.
3. D. Samanta, Classic Data Structures, 2nd Edition, PHI.

Online Resources

1. www.geeksforgeeks.org/data-structures
2. https://www.tutorialspoint.com/data_structures_algorithms/index.htm

Course Outcomes:

After completion of the course, students will be able to

1. Determine and analyze the complexity of given algorithms.
2. Implement various kinds of searching and sorting techniques.
3. Practice basic data structures such as linked list, stack and queue.
4. Design programs using advanced data structures like hash tables, binary trees, search trees, heaps and graphs.
5. Choose appropriate data structures as applied to specified problem definition.
6. Implement and know the application of algorithms for pattern matching.

II Year B.Tech. CSE (AI&ML) I-Semester **L T P C**
Course Code: PC123BJ **3 - - 3**

DATABASE MANAGEMENT SYSTEMS

(Common to CST, CSM & CSD)

Prerequisites: -Nil-

Course Objectives:

1. Understand the basic concepts and the applications of database systems.
2. Master the basics of SQL and construct queries using SQL.
3. Understand the relational database design principles.
4. Become familiar with the basic issues of transaction processing and concurrency control.
5. Become familiar with database storage structure and recovery mechanisms.

UNIT 1: (~ 10 Lecture Hours)
Introduction: Database System Applications, Purpose of Database Systems, View of Data, Database Languages – DDL, DML, Relational Databases, Data Storage and Querying, Transaction Management, Database Architecture, Database Users and Administrators.
Database Design and the E-R Model: The Entity-Relationship Model, Constraints, Removing Redundant Attributes in Entity Sets, Entity-Relationship Diagrams, Reduction to Relational schemas, Entity-Relationship Design Issues, Extended E-R Features.

UNIT 2: (~ 9 Lecture Hours)
Introduction to the Relational Model: Structure of Relational Databases, Database Schema, Schema Diagrams, The Relational Algebra, Tuple Relational Calculus, Domain Relational Calculus.
Introduction to SQL: Overview of the SQL Query Language, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, Aggregate Functions, Nested Subqueries.

UNIT 3: (~ 10 Lecture Hours)
Advanced SQL: Join Expressions, Views, Integrity Constraints, Triggers.
Normalization: Functional Dependencies, Lossless decomposition,1NF, 2NF, 3NF, Dependency Preservation, BCNF, Multi -valued dependencies, 4NF, Join Dependencies, 5NF.

UNIT 4: (~ 10 Lecture Hours)
Transaction Management: Transaction Concept, A Simple Transaction Model, Storage Structure, Transaction Atomicity and Durability, Transaction Isolation, Serializability, Transaction Isolation and Atomicity, Transaction Isolation Levels.
Concurrency Control: Lock-Based Protocols, Multiple Granularity, Timestamp-Based Protocols, Validation-Based Protocols.

UNIT 5: (~ 9 Lecture Hours)
Recovery System: Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm, Failure with loss of non-volatile storage, Remote Backup systems.
Indexing: Ordered Indices, B+ -Tree Index files.

Text Books:

1. A. Silberschatz, Henry. F. Korth and S. Sudarshan, Database System Concepts, 6th Edition, McGraw Hill Education (India) Private Limited.
2. C.J. Date, A.Kannan, and S.Swami Nadhan, An Introduction to Database systems, 8th Edition, Pearson Education.

Reference Books:

1. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, 3rd Edition, McGraw Hill Education (India) Private Limited.
2. R Elmasri, Shamkant B. Navathe, Database Systems, 6th Edition, Pearson Education.

Online Resources:

1. www.w3schools.in/
2. https://beginnersbook.com/2015/04/dbms-tutorial/

Course Outcomes:

After completion of the course, students will be able to

1. Understand concepts and the applications of database systems and implement in real time applications.
2. Construct an Entity-Relationship (E-R) model from specifications and transform to relational model.
3. Demonstrate the basic concepts of relational database management system and construct unary/binary/set/aggregate queries in Relational Algebra and in SQL.
4. Apply normalization on database.
5. Understand principles of database transaction management.
6. Understand the storage and recovery of database.

II Year B.Tech. CSE (AI&ML) I-Semester **L T P C**
Course Code: ES12370 **- - 3 1.5**

IT WORKSHOP AND PYTHON PROGRAMMING LAB

(Common to CST, CSM & CSD)

Prerequisites: -Nil-

Course Objectives:

1. Acquire knowledge of PC & its peripherals and learn installation of OS.
2. Create web pages using HTML + CSS and create spreadsheets using MS-Excel.
3. Describe the core syntax and semantics of Python programming language.
4. Illustrate the process of structuring the data using lists, dictionaries, tuples, sets and strings.
5. Handle files and modules in python
6. Develop the skills of using python libraries

List of Experiments:

Week 1: PC Hardware:

a) Identification of the peripherals of a computer, components in a CPU and its functions.
b) Draw the block diagram of the CPU along with the configuration of each peripheral.
c) Disassembling and assembling the PC back to working condition.
d) Installation of OS (Windows and Linux)

Week 2: HTML & CSS

a) Develop pages using HTML consisting of Text, images, tables, lists, Hyperlinks.
b) Develop pages using HTML frames and Style sheets.

Week 3: MS Office - Excel

Spreadsheet Orientation: Accessing, overview of toolbars, saving spreadsheet files, Using help and resources

Creating a Scheduler: Features to be covered: Gridlines, Format Cells, Freezing Rows and Columns, Selecting Ranges, Summation, auto fill, Formatting Text.

Week 4: Excel functions

Calculating Grade Point Average: Features to be covered: - Cell Referencing, Formulae – sum, average, standard deviation, Count function, Solver, Sort, Filter, Conditional formatting.

Creating Charts: Understand chart terminology, select appropriate chart types for a specific set of data, create basic chart types, including column, pie, line, XY Scatter, and bar charts

Week 5: Python Programming

Introduction to Python, variables, number data types and operators in Python.

a) Write a program to demonstrate different number data types in Python.
b) Write a program to perform different Arithmetic Operations on numbers.

Week 6: Control Flow Statements

if statement, if…else statement, if…elif…else statement, nested if statement, while loop, for loop, continue and break statements

a) Write a python program to find largest of three numbers
b) Write a Python program to convert temperatures to and from Celsius, Fahrenheit. [Formula: c/5 = f-32/9]
c) Write a Python program that prints prime numbers less than 20(using for-else).

d) Write a Python program to construct the following pattern, using a nested for loop

```
1
2 2
3 3 3
4 4 4 4
5 5 5 5 5
4 4 4 4
3 3 3
2 2
1
```

e) Write a program to get the binary form of a given number.

Week 7: Lists

Creating Lists, Basic List operations, Indexing and Slicing in Lists, Built-in functions used on Lists, List methods, List comprehension.

a) Write a program to demonstrate various list methods in python.
b) Write a program to get a list of even numbers from a given list of numbers. (use only list comprehensions)

Week 8: Tuples and Sets

Tuples: Creating Tuples, Basic Tuple operations, Indexing and Slicing in Tuples, Built-in Functions used on Tuples, Relation between Tuples and Lists.
Sets: Set Methods, operations of sets.

a) Write a program to add an item in a tuple without converting into a list.
b) Write a program to count the elements in a list until an element is a tuple.
c) Write a Python program to demonstrate set operations.

Week 9: Strings and Dictionaries

Strings: Basic String operations, String slicing and joining, String methods.
Dictionaries: Creating Dictionary, Accessing and Modifying key-value pairs in Dictionaries, Built - in functions used on Dictionaries, Dictionary methods.

a) Write a program to access a sub string from a given string (Use slicing)
- Get the first 5 characters of a string
- Get a substring of length 4 from the 3rd character of the string
- Get the last 5 characters of a string
- Get a substring which contains all characters except the last 4 characters and the 1st character
- Get every other character from a string

b) Get a string from a given string where all occurrences of its first char have been changed to '$', except the first char itself
Eg: restart output: resta$t
c) Write a program to sort a dictionary by a value.
b) Write a program to display the count of individual vowels in the input string using dictionary. (Ex: Input String: “welcome” Output: {‘a’:0,’e’:2,’i’:0,’o’:1,’u’:0})

Week 10: Functions and Modules

Functions: Built-In Functions, Function definition and calling the function, The return statement and void function, recursion.
Classes and objects.
Modules: Importing Modules, Importing Module Attributes.

a) Write a python program to find N largest element from given list of integers using functions
b) Write a python program to find sum of elements of nested list using recursion. (Input: [9, 1, [3,4], [5,2]], Output:24)
c) Write a program to implement stack data structure using class.
d) Write a python program to define a module to find Fibonacci Numbers and import the module to another program.
e) Define a module that consist of factorial and sum of individual digits of a number as functions. Write a program to find ${}^{n}c_{r}$ by importing only factorial function from the above module.

Week 11: Exception Handling and Files

Exception Handling: Catching exceptions using try and except statement, user defined exceptions

Files: Creating files, File input/output methods

a) Write a program to handle exceptions using try..except..finally…else
b) Write a program to sort words in a file and put them in another file. The output file should have only lower-case words, so any upper-case words from source must be lowered. (Handle exceptions)
c) Write a program that inputs a text file. The program should print all of the unique words in the file in alphabetical order.

Week 12: Visualization of Data using Python Libraries

Python Libraries: Introduction to python libraries and exploring Numpy, Pandas, matplotlib, seaborn.

a) Write a python program to demonstrate array operations using Numpy library.
b) Write a python program to plot a bar graph on any data set using pandas library.
c) Write a python program to plot a scatter plot on any data set using matplotlib library.
d) Write a python program to plot a box plot on any data set using seaborn library.

Text Books:

1. Introduction to Information Technology, ITL Education Solutions limited, 7th Edition, Pearson Education.
2. Manish Nigam, Advance Excel 2019 Training Guide: Tips and tricks to kick start your excel skills, BPB Publications.
3. Core Python Programming, Wesley J. Chun, Second Edition, Pearson.
4. Gowrishankar S, Veena A, Introduction to Python Programming, 1st Edition, CRC Press/Taylor Francis, 2018. ISBN-13: 978-0815394372.

Reference Books:

1. Vikas Gupta, Comdex Information Technology Course Tool Kit, WILEY Dreamtech, 2005.
2. David Anfinson and Ken Quamme, IT Essentials PC Hardware and Software Companion Guide, 3rd Edition, CISCO Press, Pearson Education.
3. Kate J. Chase, PC Hardware and A+ Handbook, PHI (Microsoft), 2004.
4. Y Daniel Liang, Introduction to Programming Using Python, 1st Edition, Pearson India, 2017.
5. John Paul Mueller, Python for Data Science for Dummies, Wiley.

Online Resources:

1. www.w3schools.org.in
2. https://www.sgul.ac.uk/about/ourprofessionalservices/informationservices/library/documents/training-manuals/ExcelFundamentals-Manual.pdf
3. www.lynda.com
4. www.coursera.org

Course Outcomes:

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

1. Apply knowledge of PC & its peripherals in assembling PC and installation of OS.
2. Develop web pages and spreadsheets.
3. Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.
4. Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples, sets and strings.
5. Develop the proficiency in handling of files and modules.
6. Make use of python libraries.

II Year B.Tech. CSE (AI&ML) I-Semester **L T P C**
Course Code: PC12372 **- - 3 1.5**

DATA STRUCTURES USING C LAB

(Common to CSM & CSD)

Prerequisites: Programming for Problem Solving

Course Objectives:

1. Learn to write programs to implement various sorting and searching algorithms.
2. Write and execute programs to solve problems using linear data structures such as arrays, linked lists, stacks and queues.
3. Write programs to implement various non-linear data structures like trees, graphs and search trees.
4. To learn and implement pattern matching techniques.

List of Experiments:

Week 1: Write a C program that uses functions to perform the following:

a. Search for a key element in a list of elements using linear search.
b. Search for a key element in a list of sorted elements using binary search.
c. Search for a key element in a list of sorted elements using interpolation search.

Week 2:

a. Write a C program that implements insertion sort algorithm to arrange a list of elements in descending order.
b. Write a C program that implements selection sort algorithm to arrange a list of elements in ascending order.
c. Write a C program that implements quick sort algorithm to arrange a list of elements in ascending order.

Week 3:

a. Write a C program that implements merge sort algorithm to arrange a list of elements in descending order.
b. Write a C program that implements radix sort algorithm to arrange a list of elements in ascending order.

Week 4:

a. Write a C program that uses functions to perform the following operations on a singly linked list: (i) Creation (ii) Insertion (iii) Deletion (iv) Display
b. Write a C program that uses functions to perform the following operations on a circularly linked list: (i) Creation (ii) Insertion (iii) Deletion (iv) Display

Week 5: Write a C program that uses functions to perform the following operations on a doubly linked list:

a. Creation b. Insertion c. Deletion d. Display

Week 6: Write a C program to implement stack using an array and a linked list.

Week 7:

a. Write a C program that uses stack operations to convert a given infix expression into its postfix equivalent. Implement the stack using an array.
b. Write a C program that uses stack operations to evaluate a given postfix expression. Implement the stack using an array.

Week 8: Write a C program to implement a queue using an array and a singly linked list.

Week 9: Write a C program that implements heap sort algorithm for sorting a list of integers in ascending order.

Week 10: Write a C program that uses functions to perform the following:

a. Create a binary search tree of integers.
b. Traverse the above binary search tree recursively in pre-order, in-order and post-order.
c. Search for an integer key in the above binary search tree recursively.
d. Traverse the above binary search tree non recursively in in-order.

Week 11: Write a C program to perform the following:

a. Traverse a given graph using DFS algorithm.
b. Traverse a given graph using BFS algorithm.

Week 12: Write a C program to perform the following:

a. To implement the functions of a dictionary using hashing
b. Implement the Brute Force and Knuth-Morris-Pratt pattern matching algorithms.

Text Books:

1. S. Sahni and Susan Anderson Freed, Fundamentals of Data Structures in C, 2nd Edition, E. Horowitz, Universities Press.
2. A. S. Tanenbaum, Y. Langsam and M. J. Augenstein, Data Structures using C – PHI/Pearson Education.

Reference Books:

1. R. F. Gilberg and B. A. Forouzan, Data Structures: A Pseudocode Approach with C, 2nd Edition, Cengage Learning.
2. D. Malhotra and N. Malhotra, Data Structures and Program Design Using C: A Self-Teaching Introduction, Mercury Learning and Information.

Online Resources:

1. www.cs.uh.edu/~rizk/teaching/cosc2430/books/Data Structures UsingC.pdf
2. www.geeksforgeeks.org/data-structures
3. https://www.tutorialspoint.com/data_structures_algorithms/index.htm

Course Outcomes:

After completion of the course, students will be able to

1. Analyze the time and space complexity of algorithm or program.
2. Implement various kinds of searching and sorting techniques.
3. Develop the programs for various linear data structures like stack, queue and linked list.
4. Implement non-linear data structures like graphs and trees.
5. Choose the appropriate data structure for solving real world problems.
6. Learn and implement different pattern matching algorithms.

II Year B.Tech. CSE (AI&ML) I-Semester **L T P C**
Course Code: PC12328 **- - 3 1.5**

DATABASE MANAGEMENT SYSTEMS LAB
(Common to CST, CSM & CSD)

Prerequisites: -Nil-

Course Objectives:
1. Understand the different issues involved in the design and implementation of a database system.
2. Learn and practice data modeling using the entity-relationship and developing database designs.
3. Understand and use data manipulation language to query, update, and manage a database.
4. Understand the significance of integrity constraints, triggers, assertions, views, procedures and cursors.

List of Experiments:
Week 1: Practicing DDL commands: Creating tables for various relations (in SQL).

Week 2: Practicing DML commands: Inserting data into relational tables.

Week 3: Practicing DRL commands: Retrieving data from tables**,** Implement all the operations like Union, Intersect, Minus, in, exist, aggregate functions (Min., Max) etc.

Week 4: Practicing Nested queries, Correlated queries, Group by and joins.

Week 5: Practicing DML commands: Updation and Deletion commands on tables

Week 6: Creating Views.

Week 7: Writing Assertions.

Week 8: Writing Triggers.

Week 9: Implementing Operations on relations (tables) using PL/SQL.

Week 10 – 12: **Case Study on Bus Reservation System**
Objective: To enable the students to practice the concepts learnt in the subject DBMS by developing a database using MySQL for example company named “Roadway Travels” whose description is as follows, The student is expected to practice the designing, developing and querying a database in the context of example database “Roadway travels”.

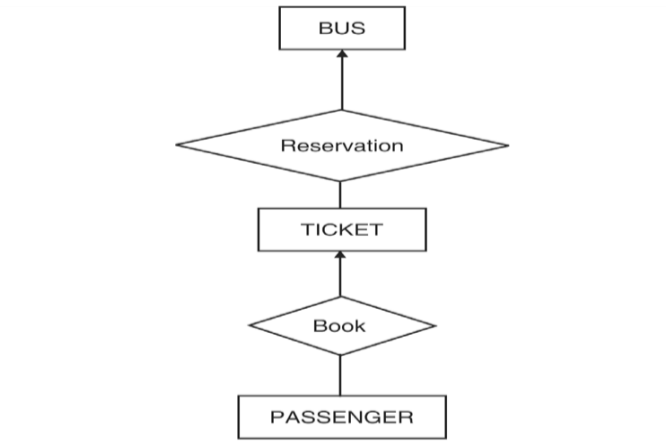
Bus reservation system:
Travelling is growing business in Telangana and other states of India, and even in some of other countries also. Buses are the public transport used to communicate between cities. The tickets for the buses have to be bought only by going to the station. This wastes a lot of time as one has to go to the station buy a ticket.

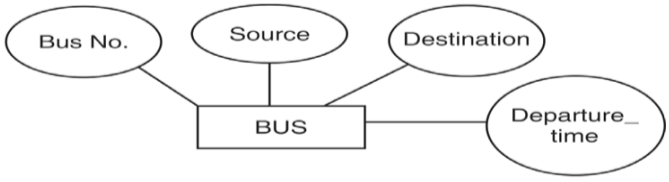
To save time and efforts, many agents are allowed to give reservation at different places of a city or town, such that we can reserve a ticket by walking to a nearest place than going to a faraway bus station. This facility made public happier. Of course we can give our cell phone number of the person who is boarding the bus such that the message will be sent to that cell phone number; such that the person can board into the bus just

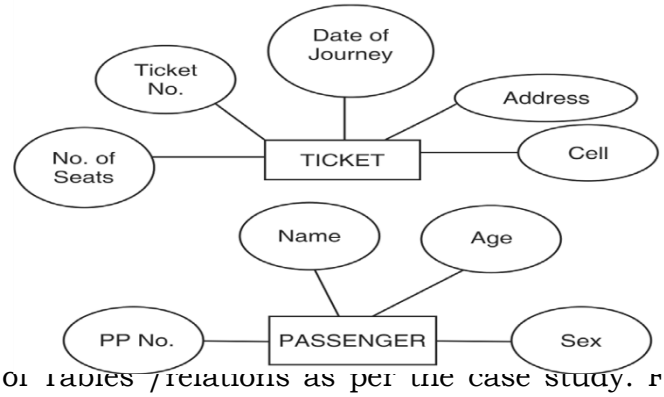
by showing the message of the cell phone without producing the printed ticket even. It is convenient for booking ticket for the children who are studying at some other place also.

Then it leads to the concept of online reservation through Internet by sitting at your home using your credit card. The state of art of private bus reservations now are a ticket can be booked online by using our table top or laptop with our credit card by giving our children cell phone number from our house, even without walking to the nearest agent. Of course, we can do reservation even at mid night, or early morning when the nearest agent's office is not available.

Enquiries can be performed by us through Internet for the availability of buses, timings and seats of different facilities. Different statistical details are required for analysis for the sake of scheduling new buses, or rescheduling the existing bus.







a) Creation of Tables /relations as per the case study. For example: BUS (Bus_No, Source, Destination, Departure_Time) Ticket (RC,Ticket_No,Bus_No, Date_of_journey, No_Seats, Cell_No, Address), Passenger (PPNO,Ticket_No, Name, Age, Sex)
b) Normalization of tables.
c) Inserting data into the tables.
d) Practice the following Queries:
    i. Display unique PPNO of all passengers.
    ii. Display all the names of male passengers.
    iii. Display the ticket numbers and names of all the passengers.
    iv. Find the names of passengers whose age is between 30 and 45.

v. Display the sorted list of passenger's names.
vi. Write a Query to display the Information present in the Passenger and cancellation tables.
vii. Find the total number of cancelled seats.

e) Design and develop the following:
i. Trigger ii. Cursor

Text Books:

1. Vikram Vaswani, The Complete Reference MySQL, 1st Edition, McGraw Hill Education (India) Private Limited.
2. Joan Casteel, Oracle 10 g: SQL, 1st Edition, Thomson Course Technology.

Reference Books:

1. A. Silberschatz, Henry. F. Korth and S. Sudarshan, Database System Concepts, 6th Edition, McGraw Hill Education (India) Private Limited.
2. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, 3rd Edition, McGraw Hill Education (India) Private Limited.

Online Resources:

1. https://dev.mysql.com/doc/
2. https://docs.oracle.com/en/database/
3. https://www.w3schools.in/

Course Outcomes:

After completion of the course, students will be able to

1. Analyze the requirements of database application.
2. Design ER model for the given problem.
3. Convert ER diagram to relational database schema.
4. Apply normalization techniques for development of application software to realistic problems.
5. Formulate queries using SQL DML/DDL/DCL commands.
6. Apply triggers, cursors and stored procedures.

II Year B.Tech. CSE (AI&ML) I-Semester **L T P C**
Course Code: MC12317 **2 - - -**

GENDER SENSITIZATION

(Common to CST, CSM & CSD)
(Mandatory Course)

Prerequisites: -Nil-

Course Objectives:

1. To develop students' sensibility with regard to issues of gender in contemporary India.
2. To provide a critical perspective on the socialization of men and women.
3. To introduce students to inform about some key biological aspects of genders.
4. To expose the students to debates on the politics and economics of work.
5. To help students reflect critically on gender violence.
6. To expose students to more egalitarian interactions between men and women.

UNIT 1: (~ 6 Lecture Hours)
Understanding Gender:
Gender: Why Should We Study It? (*Towards a World of Equals:* Unit -1)
Socialization: Making Women, Making Men (*Towards a World of Equals:* Unit - 2*)*
Introduction, Preparing for Womanhood, Growing up Male, First lessons in Caste, Different Masculinities.

UNIT 2: (~ 6 Lecture Hours)
Gender and Biology:
Missing Women: Sex Selection and Its Consequences (*Towards a World of Equals:* Unit - 4) Declining Sex Ratio. Demographic Consequences.
Gender Spectrum: Beyond the Binary (*Towards a World of Equals:* Unit -10)
Two or Many? Struggles with Discrimination.

UNIT 3: (~ 7 Lecture Hours)
Gender And Labour:
Housework: The Invisible Labour (*Towards a World of Equals:* Unit -3)
"My Mother doesn't Work." "Share the Load."
Women's Work: Its Politics and Economics (*Towards a World of Equals:* Unit -7)
Fact and Fiction. Unrecognized and Unaccounted work.
Additional Reading: Wages and Conditions of Work.

UNIT 4: (~ 7 Lecture Hours)
Issues of Violence:
Sexual Harassment: Say No! (*Towards a World of Equals:* Unit -6)
Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading: "Chupulu".
Domestic Violence: Speaking Out (*Towards a World of Equals:* Unit -8)
Is Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives.
Additional Reading: New Forums for Justice - Thinking about Sexual Violence (*Towards a World of Equals:* Unit -11) - Blaming the Victim- "I Fought for my Life…." - Additional Reading: The Caste Face of Violence.

UNIT 5: (~ 6 Lecture Hours)
Gender: **Co - Existence**
Just Relationships: Being Together as Equals (*Towards a World of Equals:* Unit -12)
Mary Kom and Onler, Love and Acid just do not Mix, Love Letters, Mothers and Fathers,
Additional Reading: Rosa Parks-The Brave Heart.

Text Books:

All the five Units in the Textbook, "**Towards a World of Equals: A Bilingual Textbook on Gender**" written by A. Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote, Vasudha Nagaraj,Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu and published by **Telugu Akademi**, **Hyderabad**, Telangana State in the year 2015.

Reference Books:

1. Menon and Nivedita, Seeing like a Feminist, Zubaan-Penguin Books, New Delhi, 2012.
2. Abdulali Sohaila, "I Fought For My Life…and Won", Available online at: http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/

Online Resources:

1. http://textofvideo.nptel.ac.in/110105080/lec20.pdf

Course Outcomes:

Students will have developed a better understanding of important issues related to gender in contemporary India.

1. Students will be sensitized to basic dimensions of the biological, sociological, psychological and legal aspects of gender. This will be achieved through discussion of materials derived from research, facts, everyday life, literature and film.
2. Students will attain a finer grasp of how gender discrimination works in our society and how to counter it.
3. Students will acquire insight into the gendered division of labour and its relation to politics and economics.
4. Men and women students and professionals will be better equipped to work and live together as equals.
5. Students will develop a sense of appreciation of women in all walks of life.
6. Through providing accounts of studies and movements as well as the new laws that provide protection and relief to women, the textbook will empower students to understand and respond to gender violence.

II Year B.Tech. CSE (AI&ML) II-Semester **L T P C**
Course Code: HS124BD **3 - - 3**

MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

(Common to CST, CSM & CSD)

Prerequisites: -Nil-

Course Objectives:

1. To provide the basic concepts of economics.
2. To interlink the concepts of economics for effective business decision making.
3. To provide fundamental knowledge of accounting, process of preparing accounting statements and interpret them thereby.

UNIT 1: (~ 9 Lecture Hours)
Managerial Economics and Demand Analysis:
Managerial Economics: Introduction to Economics, Definition of Managerial Economics, Nature and Scope of Managerial Economics, Multidisciplinary nature of Managerial Economics, Role of Managerial Economist.
Demand Analysis: Introduction to Demand, Determinants of demand, Law of demand and its Exceptions, Nature of demand, Movement and Shift of demand curve.

UNIT 2: (~ 9 Lecture Hours)
Elasticity of Demand, Demand Forecasting and Production Analysis:
Elasticity of demand: Concept of Elasticity of demand, Types of Elasticity- Price, Income, Cross and Advertising. Factors affecting and Significance of Elasticity of demand.
Demand Forecasting: Need for Demand Forecasting - Factors governing Demand Forecasting, Methods of Demand Forecasting (Survey methods and Statistical methods).
Production Analysis: Factors of Production, Production Function, Production function with one variable input, two variable inputs using Isoquant and Isocosts. Optimal combination of Resources using Isoquants and Isocosts, Laws of returns, Economies and Diseconomies of Scale.

UNIT 3: (~ 10 Lecture Hours)
Cost Analysis, Market Structure and Pricing:
Cost Analysis: Cost concepts, Short run and Long run Cost analysis.
Market Structures: Classification of Markets, Features of Perfect Competition, Monopoly, Monopolistic, Oligopoly and Duopoly.
Pricing: Pricing Objectives, Methods of Pricing and Pricing Strategies.

UNIT 4: (~10 Lecture Hours)
Introduction to Financial Accounting:
Financial Accounting: Introduction to Accounting, Double Entry Book-Keeping, Accounting Principles, Accounting Terminology, Journal, Ledger, Trial Balance, Final Accounts with Adjustments (Simple Problems).

UNIT 5: (~10 Lecture Hours)
Financial Analysis and Interpretation:
Ratio Analysis: Need, importance and significance of Ratio Analysis, Liquidity Ratios, Profitability Ratios, Activity Ratios, Solvency Ratios, Interpretation of Ratios for decision making (Simple problems).

Reference Books:

1. P L Mehta, Managerial Economics, Analysis, Problems & Cases, 8th Edition, Sultan Chand & Sons, 2001.
2. S.N. Maheshwari, Suneel K Maheshwari, Sharad K. Maheshwari, Financial Accounting, 5th Edition, Vikas Publishing House Pvt. Ltd, 2015.
3. D.N.Dwivedi, Managerial Economics, 9th Edition, Vikas Publishing House Pvt. Ltd., 2016.
4. R.L.Varshney and K.L Maheshwari, Managerial Economics, 14th Edition, Sultan Chand & Sons, 2005.
5. T.S.Grewal, Double Entry Book Keeping, Sultan Chand & Sons, Reprint 2006.

Online Resources:

1. Managerial Economics http://nptel.ac.in/courses/110101005/162.
2. Financial Accounting http://nptel.ac.in/courses/110107073.

Course Outcomes:

After completion of the course, students will be able to

1. Cognize the Basic Concepts of Economics.
2. Analyze the economic concepts for using discretion in business problem solving.
3. Comprehend the concepts of Accounting for business decision making.
4. Assimilate the basic Accounting Procedure and interpret the statements.
5. Analogize the external business environment for attainment of business goals.
6. Enable forecasting and analyzing the external business environment.

II Year B.Tech. CSE (AI&ML) II-Semester	**L**	**T**	**P**	**C**
Course Code: PC124BH	**3**	**-**	**-**	**3**

COMPUTER ORGANIZATION AND ARCHITECTURE

(Common to CST, CSM & CSD)

Prerequisites: Digital Logic Design

Course Objectives:

1. Know the basic components of computers.
2. Understand the architecture of 8086 processor.
3. Learn the instruction sets, instruction formats and various addressing modes of 8086.
4. Understand the memory and I/O organization.
5. Understand the parallelism both in terms of single and multiple processors.

UNIT 1: (~ 10 Lecture Hours)
Functional Blocks of a Computer: Introduction, Block diagram of digital computer, Instruction codes, Computer Registers, Common bus system, Computer instructions, Instruction cycle and Instruction set, Register Transfer Language.
Data Representation: Fixed and floating point arithmetic-Addition, Subtraction, Multiplication, Division.
Control unit Design: Hardwired control unit**,** Control memory, Address sequencing, Micro-programmed control unit design, Hardwired Vs Micro-programmed design.

UNIT 2: (~ 10 Lecture Hours)
The 8086 Microprocessor: Architecture, Register organization, 8086 signal description, Physical memory organization, Minimum and Maximum mode system and timing diagrams, Addressing modes, 8086 Instruction Set and Assembler Directives, Assembly Language example programs, Stack structure of 8086, Interrupt structure of 8086, Interrupt vector table, Procedures and macros.

UNIT 3: (~ 7 Lecture Hours)
Peripheral Devices and their characteristics: Introduction, Input-Output Interface, Modes of Transfer-Programmed I/O, Priority Interrupt, Direct memory Access, Input – Output Processor (IOP), Intel 8089 IOP, Standard I/O interfaces – PCI, USB, SCSI.

UNIT 4: (~ 8 Lecture Hours)
Memory Organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory - Mapping functions, Replacement algorithms, Write policies.

UNIT 5: (~ 10 Lecture Hours)
Pipelining: Introduction, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Vector Processing, Array Processors, Hazards.
Multiprocessors: Characteristics of Multiprocessors, Interconnection Structures, Inter processor arbitration, Inter processor communication and synchronization, Cache coherence.

Text Books:

1. M. Morris Mano, Computer System Architecture, 3rd Edition, Pearson.
2. K. M. Bhurchandi and A.K Ray, Advanced Microprocessors and Peripherals, 3rd Edition, Tata McGraw-Hill Education.

Reference Books:

1. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, 5th Edition, Elsevier.
2. Carl Hamacher, Computer Organization and Embedded Systems, 6th Edition, McGraw Hill Higher Education.
3. William Stallings, Computer Organization and Architecture: Designing for Performance, 10th Edition, Pearson Education.

Online Resources:

http://nptel.ac.in/courses/106103068/pdf/coa.pdf

Course Outcomes:

After completion of the course, students will be able to

1. Recognize the basic components and the design of CPU, ALU and Control Unit.
2. Know the architecture of 8086.
3. Realize the instruction set, instruction formats and addressing modes of 8086.
4. Write assembly language programs for problem solving.
5. Understand the memory hierarchy and I/O organization.
6. Comprehend the advantage of instruction level parallelism and pipelining for high performance Processor design.

II Year B.Tech. CSE (AI&ML) II-Semester	**L**	**T**	**P**	**C**
Course Code: PC124BN	**3**	**-**	**-**	**3**

OPERATING SYSTEMS

(Common to CST, CSM & CSD)

Prerequisites: Data Structures using C

Course Objectives:

1. To understand the role of OS in the overall computer system and study the operations performed by OS as a resource manager.
2. To understand the scheduling policies and different memory management techniques for different operating systems.
3. To understand process concurrency and synchronization.
4. To understand the concepts of I/O, storage and file management and introduce system call interface for file and process management.
5. To introduce the goals and principles of protection.

UNIT 1: (~ 10 Lecture Hours)
Introduction: Overview-Introduction-Operating system objectives, User view, System view, Operating system definition, Computer System Organization, Computer System Architecture, OS Structure, OS Operations, Process Management, Memory Management, Storage Management, Protection and Security, Computing Environments.
Operating System services, User and OS Interface, System Calls, Types of System Calls, System Programs, Operating System Design and Implementation, OS Structure.

UNIT 2: (~ 9 Lecture Hours)
Process: Process concepts-The Process, Process State, Process State transitions, Process Control Block, Context Switch.
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 3: (~ 10 Lecture Hours)
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 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, Recovery from Deadlock.

UNIT 4: (~ 10 Lecture Hours)
Memory Management: Basic Hardware, Address Binding, Logical and physical address space, Dynamic loading, linking and Shared libraries, Swapping, Contiguous Memory Allocation- Fixed and variable partition–Internal and External fragmentation and Compaction; Segmentation, Paging- Hardware support for paging, Protection, shared pages, Structure of Page Table. Case Studies: Linux, Windows.
Virtual Memory Management: Background, Demand Paging-locality of reference, Page fault; Copy-on-Write, Page replacement, Page Replacement Algorithms, Allocation of Frames, Thrashing.

UNIT 5: (~ 9 Lecture Hours)
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.
Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk formatting- Boot-block, Bad blocks.
Protection: System Protection, Goals of Protection, Principles of Protection.

Text Books:

1. Abraham Silberschatz, Peter B.Galvin, 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.

Reference Books:

1. Charles Crowley, Operating System: A Design-oriented Approach, 1st Edition, Irwin Publishing.
2. Gary J. Nutt, 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, Marco Cesati, Understanding the Linux Kernel, 3rd Edition, O'Reilly and Associates.

Online Resources:

1. Abraham-Silberschatz-Operating-System-Concepts---9th 2012.12.pdf
2. https://www.cs.uic.edu/~jbell/CourseNotes/OperatingSystems/

Course Outcomes:
After completion of the course, students will be able to

1. Acquire a High-level understanding of what is an operating system and the role it plays and the services it provides.
2. Understand process management concepts including scheduling, synchronization.
3. Describe System model for deadlock, Methods for handling deadlocks.
4. Understand memory management including virtual memory.
5. Acquire Knowledge on issues related to file system interface and implementation.
6. Understand the issues related to disk management.

II Year B.Tech. CSE (AI&ML) II-Semester	**L**	**T**	**P**	**C**
Course Code: PC124AX	**3**	**1**	**-**	**4**

OBJECT ORIENTED PROGRAMMING

(Common to CST, CSM & CSD)

Prerequisites: Programming for Problem Solving

Course Objectives:

1. Learn the concepts of object oriented programming.
2. Introduce the implementation of inheritance, packages and interfaces.
3. Understand the concepts of exception handling and multithreading.
4. Introduce the java collection framework and I/O classes.
5. Gain knowledge in designing Graphical User Interface using applets and swing controls.

UNIT 1: (~ 8 Lecture Hours)
OOP concepts: Data abstraction, encapsulation, inheritance, polymorphism, classes and objects, Procedural and Object oriented programming paradigms.
Java Basics: History of Java, Java buzzwords, Data types, Variables, Arrays, operators, expressions, control statements, Introducing classes, Methods, Constructors, Inner classes, Anonymous Inner classes, String handling.

UNIT 2: (~ 10 Lecture Hours)
Inheritance: Inheritance concepts, Member access, Creating Multilevel hierarchy, using super, using final with inheritance, forms of inheritance, benefits of inheritance, costs of inheritance, Polymorphism-Adhoc polymorphism, pure polymorphism, method overriding, abstract classes, Object class.
Packages: Defining a Package, CLASSPATH, Access protection, importing packages.
Interfaces: Defining an interface, implementing interfaces, Nested interfaces, variables in interfaces and extending interfaces.

UNIT 3: (~ 10 Lecture Hours)
Exception handling: Fundamentals of exception handling, Exception types, using try and catch, multiple catch clauses, nested try statements, throw, throws and finally, built-in exceptions, creating own exception sub classes.
Multithreading: Differences between thread-based multitasking and process-based multitasking, Java thread model, creating threads, thread priorities, synchronizing threads, inter thread communication.

UNIT 4: (~ 10 Lecture Hours)
Stream based I/O (java.io): The Stream classes - Byte streams and Character streams, Reading Console Input and Writing Console Output, File class, Reading and Writing files, Random access file operations, Generics, Enumerations.
The Collections Framework (java.util): Collections overview, Collection Interfaces, The Collection classes - ArrayList, LinkedList, Iterator, The For-Each alternative, HashTable, Properties, Stack, Vector, StringTokenizer, Calendar, Random, Scanner.

UNIT 5: (~ 10 Lecture Hours)
Event Handling: The Delegation Event Model - Events, Event sources, Event Listeners, Event classes, Handling mouse and keyboard events, Adapter classes.
GUI Programming with Swing: Introduction, limitations of AWT, MVC architecture, Swing components, Swing containers, Swing Controls - JLabel, JTextField, JButton, JToggleButton, JCheckBox, JRadioButton, JTabbedPane, JScrollPane, JList, JComboBox, Swing Menus, Dialogs. Layout Managers-FlowLayout, BorderLayout, GridLayout, CardLayout, GridBagLayout.

Applets: The Applet class, Difference between Applets and Applications, Life Cycle of an Applet, passing parameters to applets.

Text Books:

1. Herbert Schildt, Java: The Complete Reference, 9th Edition, McGraw Hill Education (India) Pvt. Ltd.
2. Herbert Schildt and Dale Skrien, Java Fundamentals - A comprehensive Introduction, McGraw Hill Education (India) Pvt. Ltd., 2013.

Reference Books:

1. Jaime Nino and Frederick. A. Hosch, An Introduction to Programming and Object Oriented Design using Java, John Wiley & sons, 2013.
2. Timothy Budd, Understanding Object-Oriented Programming with Java, updated Edition, Pearson Education.
3. Y. Daniel Liang, Introduction to Java Programming, Comprehensive Version, 7th Edition, Pearson Education.
4. P. Radha Krishna, Object Oriented Programming through Java, Universities Press, 2008.

Online Resources:

1. https://docs.oracle.com/javase/tutorial/java/TOC.html
2. www.javatpoint.com/java-tutorial

Course Outcomes:

After completion of the course, students will be able to

1. Understand the object oriented programming concepts and solve real world problems.
2. Demonstrate the use of inheritance and packages.
3. Understand and implement the concepts of exception handling.
4. Develop multithreaded applications with synchronization.
5. Solve problems using java collection framework and I/O classes.
6. Design Graphical User Interface using applets and swing controls.

II Year B.Tech. CSE (AI&ML) II-Semester	**L**	**T**	**P**	**C**
Course Code: PC124NB	**3**	**-**	**-**	**3**

INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Prerequisites: Data Structures using C, Discrete Mathematics

Course Objectives:

1. To learn the difference between optimal reasoning vs human like reasoning.
2. To understand the notions of state space representation, exhaustive search, heuristic search.
3. To learn different knowledge representation techniques.
4. To understand the applications of AI like Game Playing and Expert Systems.
5. To Introduce the concept of Machine Learning

UNIT 1: (~ 10 Lecture Hours)

Introduction: History, Intelligent Systems, Foundations of AI, Sub areas of AI & Applications.

Problem Solving - State-Space Search and Control Strategies, General Problem Solving Techniques Characteristics of Problem, Exhaustive Searches, Heuristic Search Techniques, Iterative-Deepening A*, Constraint Satisfaction. Game Playing, Bounded Look-ahead Strategy and use of Evaluation Functions, Alpha-Beta Pruning.

UNIT 2: (~ 9 Lecture Hours)

Logic Concepts and Logic Programming: Introduction, Propositional Calculus, Propositional Logic, Natural Deduction System, Axiomatic System, Semantic Tableau System in Propositional Logic, Resolution Algorithm, Predicate Logic, Logic Programming.

UNIT 3: (~ 10 Lecture Hours)

Knowledge Representation: Introduction, Approaches to Knowledge Representation, Knowledge Representation using Semantic Network, Extended Semantic Networks for KR, Knowledge Representation using Frames.

Advanced Knowledge Representation Techniques: Case Grammars, Semantic Web

UNIT 4: (~ 10 Lecture Hours)

Uncertainty Measure - Probability Theory: Introduction, Probability Theory, Bayesian Belief Networks, Certainty Factor Theory, Dempster-Shafer Theory.

Introduction to Machine Learning: Machine Learning Systems, Supervised and unsupervised learning, Inductive and Deductive learning.

UNIT 5: (~ 10 Lecture Hours)

Expert System and Applications: Introduction, Phases in Building Expert Systems, Expert System Architecture, Expert Systems Vs Traditional Systems, Rule based Expert Systems, Truth Maintenance Systems, Applications of Expert Systems, List of Shells and Tools.

Text Books:

1. Saroj Kaushik, Artificial Intelligence, Cengage Learning, 2011.

Reference Books:

1. Rich, Knight, Nair: Artificial intelligence, Tata McGraw Hill, Third Edition, 2009.
2. Eugene Charniak, Introduction to Artificial Intelligence, Pearson, 2007.
3. Dan W.Patterson, Introduction to Artificial Intelligence and Expert Systems, PHI, 1990.
4. George Fluger, Artificial Intelligence, 5th Edition, Pearson.

Online Resources:

1. http://www.vssut.ac.in/lecture_notes/lecture1428643004.pdf
2. http://nptel.ac.in/courses/106105077/
3. https://onlinecourses.nptel.ac.in/noc18_cs18/preview
4. https://www.edx.org/course/artificial-intelligence-ai-columbiax-csmm-101x-4

Course outcomes:

After completion of the course, students will be able to

1. Understand the basics of AI and to formulate efficient problem space and select a search algorithm for a problem.
2. Apply AI techniques to solve problems related to Game playing, Expert systems.
3. Develop Logic programming skills.
4. Represent knowledge using appropriate techniques.
5. Interpret probabilistic and logical reasoning for knowledge.
6. Understand the concept of machine learning.

II Year B.Tech. CSE (AI&ML) II-Semester **L T P C**
Course Code: PC12427 **- - 3 1.5**

COMPUTER ORGANIZATION AND MICROPROCESSOR LAB

(Common to CSM & CSD)

Prerequisites: Digital Logic Design

Course Objectives:

1. Design and implement combinational circuits using logic gates.
2. Analyze and design sequential circuits using logic gates.
3. Write programs in Assembly language to solve the problems.
4. Understand, compile and debug the programs.

List of Experiments:

Week 1:

Implement the following experiments using Logic gates and IC's

a. Logic gates using universal gates.
b. Design a Full adder.
c. Design 4x1 and 8x1 MUX.

Week 2:

Implement the following experiments using Logic gates and IC's

a. Design a 3 to 8 decoder. b. Design a 4-bit comparator.

Week 3:

Implement the following experiments using Flip-flops

a. Design a 4-bit shift register. b. Design a decade counter.

Week 4:

Write an Assembly Language Program (ALP) to evaluate the expressions a=b+c-d*e and z=x*y+w-v+u/k. Considering 8-bit, 16-bit and 32-bit binary numbers as b, c, d, e, k, u, v, w, x and y.

Week 5:

Write an ALP of 8086 to take N numbers as input and arrange them in ascending and descending order.

Week 6:

Write an ALP of 8086 to take N numbers as input and do the following operations on them

a. Find maximum and minimum. b. Find average

Week 7:

Write an ALP of 8086 to take a string as input and do the following operations on it

a. Find the length. b. Find whether it is Palindrome or not.

Week 8:

Write an ALP of 8086 to take a string as input and find whether given string is substring or not.

Week 9:

Write an ALP of 8086 to take a number as input and find the factorial using a procedure call.

Week 10:
Write an ALP of 8086 to take a number as input and find the Fibonacci series up to n terms using a procedure call.

Week 11:
Write an ALP of 8086 for interfacing with Analog to Digital Converter.

Week 12:
Write an ALP of 8086 for interfacing with Digital to Analog Converter.

Text Books:
1. M. Morris Mano, Computer System Architecture, 3rd Edition, Pearson.
2. K. M Bhurchandi and A.K Ray, Advanced Microprocessors and Peripherals, 3rd Edition, Tata McGraw-Hill Education.

Reference Books:
1. Anand Kumar, Switching theory and logic design, 2013, PHI.
2. Douglas V. Hall, Microprocessor and Interfacing, 2nd Edition, Tata McGraw-Hill Education.

Online Resources:
http://nptel.ac.in/courses/106103068/pdf/coa.pdf

Course Outcomes:
After completion of the course, students will be able to
1. Design combinational circuits using logic gates.
2. Design sequential circuits using logic gates.
3. Recognize the representation of data, addressing modes and instructions sets.
4. Write and execute programs in Assembly language to solve the problems.
5. Compile and debug the programs.
6. Analyze and interface different peripherals with the microprocessor.

II Year B.Tech. CSE (AI&ML) II-Semester **L T P C**
Course Code: PC12433 **- - 3 1.5**

OPERATING SYSTEMS LAB

(Common to CST, CSM & CSD)

Prerequisites: Programming for Problem Solving, Data Structures using C

Course Objectives:

1. To write programs in Linux environment.
2. To implement the scheduling algorithms.
3. To develop solutions for synchronization problems using semaphores.
4. To implement page replacement algorithms and other memory management techniques.
5. To implement file allocation methods.

List of Experiments:

Use Linux operating system and GNU C compiler:

Week 1: Programs using system calls

a. Write a C program to simulate ls | sort command.
b. Write a C program to implement the Process system calls. Create a new process, create a child process to it and then make it wait and abort.
c. Write a C program to simulate copy the contents of one file to another using system calls.

Week 2: Write C programs to simulate the following CPU scheduling algorithms:

a. FCFS b. SJF

Week 3: Write C programs to simulate the following CPU scheduling algorithms:

a. Priority b. Round Robin

Week 4: Write a C program to solve the Producer- Consumer problem using semaphores.

Week 5: Write a C program to solve the Dining- Philosopher problem using monitors.

Week 6: Write a C program to simulate Bankers Algorithm for Dead Lock Avoidance.

Week 7: Write a C program to simulate Bankers Algorithm for Dead Lock Prevention.

Week 8: Write C program to simulate the paging technique of memory management.

Week 9: Write C program to simulate the segmentation technique of memory management.

Week 10: Write C programs to simulate the following page replacement algorithms:

a. FIFO b. LRU

Week 11: Write C programs to simulate the following Directory organization techniques:

a. Single level directory b. Two level directory

Week 12: Write C programs to simulate the following File allocation methods:

a. Contiguous b. Linked

Text Books:

1. Abraham Silberschatz, Peter 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.

Reference Books:

1. P.C.P Bhatt, An Introduction to Operating Systems, 2nd Edition, PHI.
2. Terrence Chan, Unix System Programming Using C++, PHI/ Pearson.
3. Andrew S Tanenbaum, Modern Operating Systems, 3rd Edition, PHI.

Online Resources:

1. http://codex.cs.yale.edu/avi/os-book/OS9/
2. www.cs.uic.edu/~jbell/CourseNotes/OperatingSystems

Course Outcomes:

After completion of the course, students will be able to

1. Design and solve synchronization problems.
2. Simulate and implement scheduling concepts.
3. Model a deadlock situation and implementing methods for handling deadlocks.
4. Simulate and implement memory management techniques.
5. Simulate and implement various file management concepts.
6. Use different system calls for writing application programs.

II Year B.Tech. CSE (AI&ML) II-Semester **L T P C**
Course Code: PC12423 **- - 3 1.5**

OBJECT ORIENTED PROGRAMMING THROUGH JAVA LAB

(Common to CST, CSM & CSD)

Prerequisites: Programming for Problem Solving

Course Objectives:

1. Develop skills to apply object oriented programming in problem solving.
2. Demonstrate the use of inheritance and interfaces.
3. Implement the concepts of exception handling and multithreading.
4. Solve problems using java collection framework and I/O classes.
5. Write GUI programs using applets and swing controls.

Note: Use Linux for Lab Experiments. Though not mandatory, encourage the use of Eclipse platform.

List of Experiments:

Week 1:

Write a Java program that prints all real solutions to the quadratic equation $ax^2+bx+c=0$. Read in a, b, c and use the quadratic formula. If the discriminant b^2-4ac is negative, display a message stating that there are no real solutions.

Week 2:

a. Write a Java program that demonstrates constructor overloading.
b. Write a Java program to implement the use of inner classes.

Week 3:

a. Write a Java program to create an abstract class named 'Shape' that contains two integers and an empty method named printArea( ). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method printArea( ) that prints the area of the given shape.
b. Write a Java program that implements multiple inheritance.
c. Write a Java program that demonstrates method overriding.

Week 4:

a. Write a Java program that implements a multi-threaded application that has three threads. First thread generates random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number.
b. Write a Java program that implements producer – consumer problem using the concept of Inter thread communication.

Week 5:

a. Write a Java program to list all the files in a directory including the files present in all its subdirectories.
b. Write a Java program for the following:
   i) Create a doubly linked list of elements.
   ii) Delete a given element from the above list.
   iii) Display the contents of the list after deletion.

Week 6:

Write a Java program that loads names and phone numbers from a text file where the data is organized as one line per record and each field in a record is separated by a tab (\t). It takes a name or phone number as input and prints the corresponding other value from the hash table (hint: use hash tables).

Week 7:

a. Develop an applet that displays a simple message.
b. Develop an applet in java that receives an integer in one text field, and computes its factorial value and returns it in another text field, when the button named "Compute" is clicked.

Week 8:

Write a Java program that creates a user interface to perform integer divisions. The user enters two numbers in the text fields, Num1 and Num2. The division of Num1 and Num 2 is displayed in the Result field when the Divide button is clicked. If Num1 or Num2 are not integers, the program would throw a Number Format Exception. If Num2 is Zero, the program would throw an Arithmetic Exception. Display the exception in a message dialog box.

Week 9:

Write a Java program that works as a simple calculator. Use a GridLayout to arrange buttons for the digits and for the +, -, *, % operations. Add a text field to display the result. Handle any possible exceptions like divide by zero.

Week 10:

Write a Java program that simulates a traffic light. The program lets the user select one of the three lights: red, yellow or green with radio buttons. On selecting a button, an appropriate message with "Stop" or "Ready" or "Go" should appear.

Week 11:

Write a Java program that handles all mouse events and shows the event name at the center of the window when a mouse event is fired. (Use Adapter classes).

Week 12:

Suppose that a table named Table.txt is stored in a text file. The first line in the file is the header, and the remaining lines correspond to rows in the table. The elements are separated by commas. Write a Java program to display the table using Labels in Grid Layout.

Text Books:

1. Herbert Schildt, Java- The Complete Reference, 9th Edition, McGraw Hill Education (India) Pvt. Ltd.
2. Paul Deitel and Harvey Deitel, Java- How to Program, Early Objects, 10th Edition, Pearson Education.

Reference Books:

1. Bruce Eckel, Thinking in Java, 3rd Edition, Pearson Education.
2. Cay S. Horstmann and Gary Cornell, Core Java, Volume 1-Fundamentals, 9th Edition, Pearson Education.

Online Resources:

1. http://docs.oracle.com/javase/tutorial/java/TOC.html
2. www.javatpoint.com/java-tutorial

Course Outcomes:

After completion of the course, students will be able to

1. Implement the concepts of object oriented programming to solve problems.
2. Develop programs using inheritance and interfaces.
3. Understand and implement the concepts of exception handling.
4. Develop multithreaded applications with synchronization.
5. Solve problems using java collection framework and I/O classes.
6. Develop GUI based applications using applets and swing controls.

II Year B.Tech. CSE (AI&ML) II-Semester **L T P C**
Course Code: MC124BE **2 - - -**

ENVIRONMENTAL SCIENCES

(Common to CST, CSM & CSD)
(Mandatory Course)

Prerequisites: -Nil-
Course Objectives:

1. Understanding the importance of ecological balance for sustainable development.
2. Understanding the impacts of developmental activities and mitigation measures.
3. Understanding the environmental policies and regulations.
4. Create awareness about environmental issues & identify the sustainable solutions.
5. To sensitize the young minds to wildlife environment.
6. To develop the knowledge on various environmental components and their interrelation with each other.

UNIT 1: (~ 5 Lecture Hours)
Ecosystems: Definition, Scope and Importance of ecosystem. Classification, structure and function of an ecosystem, food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Bio-magnification, ecosystem value, services and carrying capacity, Field visits.

UNIT 2: (~ 7 Lecture Hours)
Natural Resources: Introduction, Classification of Resources, Living and Non-Living resources, Water Resources**:** use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. Mineral Resources: use and exploitation, environmental effects of extracting and using mineral resources. Land Resources, Energy Resources: growing energy needs, renewable and non-renewable energy sources, use of alternate energy source, case studies.

UNIT 3: (~ 6 Lecture Hours)
Biodiversity and Biotic Resources: Introduction, Definition, genetic, species and ecosystem diversity, value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity, Field visit Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; Conservation of biodiversity: In-Situ and Ex-situ conservation.

UNIT 4: (~ 7 Lecture Hours)
Environmental Pollution and Control Technologies: Classification of pollution, Air Pollution: Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. Water pollution: Sources and types of pollution, drinking water quality standards. Soil Pollution**:** Sources and types, Impacts of modern agriculture, degradation of soil. Noise Pollution: Sources and Health hazards, standards, Solid waste: Municipal Solid Waste management, composition and characteristics of e-Waste and its management.

Global Environmental Problems and Global Efforts: Climate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol, and Montréal Protocol.

UNIT 5: (~ 6 Lecture Hours)
Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, Hazardous Waste (Management and Handling) Rules. EIA: EIA structure, methods of baseline data

acquisition. Overview on Impacts of air, water, biological and Socio-economical aspects. Strategies for risk assessment, Concepts of Environmental Management Plan (EMP).
Towards Sustainable Future: Concept of Sustainable Development, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building.

Text Books:

1. Erach Bharucha, Text book of Environmental Studies for Undergraduate Courses, University Grants Commission.
2. R. Rajagopalan, Environmental Studies, Oxford University Press.

Reference Books:

1. Richard T. Wright, Environmental Science: towards a sustainable future, PHL Learning Private Ltd. New Delhi, 2008.
2. Gilbert M. Masters and Wendell P. Ela, Environmental Engineering and science, PHI Learning Pvt. Ltd., 2008.
3. Daniel B. Botkin & Edward A. Keller, Environmental Science, Wiley INDIA Edition.
4. Anubha Kaushik, Environmental Studies, 4th Edition, New age international publishers.
5. Dr. M. Anji Reddy, Text book of Environmental Science and Technology, BS Publications, 2007.

Online Resources:

1. http://www.open.edu/openlearn/free-courses/full-catalogue
2. https://www.edx.org/course/subject/environmental-studies
3. https://www.mooc-list.com/tags/environmental-management
4. https://www.enviroblog.net

Course Outcomes:

After completion of the course, students will be able to

1. Benefited by various ecological principles and environmental regulations for sustainable development.
2. Able to identify/analyze/evaluate/demonstrate the consequences of developmental activities and mitigation measures.
3. Develop the advanced technologies in protection/conservation of resources in sustainable approach.
4. Improved in attitude & thinking of the students will be positively towards earth & environment.
5. Benefited by knowing the concepts like Green Buildings, Low Carbon Lifestyle, International conventions etc.
6. It helps the students to improve the quality of life.

III Year B.Tech. CSE (AI&ML) I-Semester **L T P C**
Course Code: **3 - - 3**

FUNDAMENTALS OF MANAGEMENT

(Common to CSE, CSE (AI&ML), CSE (DS), CST, ETE, EEE, ECE & IT)

Prerequisites: Managerial Economics and Financial Analysis

Course Objectives:

1. To educate the importance of Management in Business Decision Making.
2. To implant the conceptual aspects required for Managerial Decision Making.
3. To elicit the practical application of Management in Engineering Decision Making.

UNIT 1: (~ 10 Lecture Hours)
Introduction to Management:
Management: Definition - Nature and Scope– Functions - Managerial Roles -Levels of Management - Managerial Skills - Challenges of Management - Evolution of Management- Classical Approach- Scientific Management and Administrative Theory - The Behavioral approach - The Quantitative approach - The Systems Approach - Contingency Approach– Corporate Social Responsibility for Businesses.

UNIT 2: (~ 07 Lecture Hours)
Planning and Decision Making
Planning: General Framework for Planning - Planning Process - Types of Plans and Types of Planning - Management by Objectives - Development of Business Strategy - Strategic Planning Process – Environmental Scanning.
Decision Making–Characteristics of Decision Making - Types of Decisions - Steps in Decision Making - Approaches to Decision Making - Individual Decision Making and Group Decision Making.

UNIT 3: (~ 10 Lecture Hours)
Organization and HRM
Organization: Principles of Organization - Organizational Design – Departmentation – Delegation – Empowerment – Centralization – Decentralization – Recentralization - Organizational Structures –Organizational Culture - Organizational Climate and Organizational Change.
Human Resource Management: Talent Management – Importance -Human Resource Planning - Recruitment and Selection - Training and Development - Performance Appraisal - Transitioning.

UNIT 4: (~10 lectures)
Leading and Motivation
Leading: Leadership - Characteristics of a Leader - Power and Authority - Leadership Styles -Leadership Theories – Traditional Leadership Theories -Behavioral Leadership Theories - Situational Leadership Theories - Leader as Mentor and Coach – Team Leadership.
Motivation - Types of Motivation - Relationship between Motivation and Performance - Content Motivational Theories –Abraham Maslow's Need Hierarchy Theory -Fredrick Herzberg's Two Factor Theory– Mc. Gregor Theory -X and Y.

UNIT 5: (~10 lectures)
Controlling: Control - Types and Strategies for Control - Steps in Control Process - Methods of Budgetary and Non- Budgetary Controls - Characteristics of Effective Controls - Establishing control systems.

Text Books:

1. Stephen P. Robbins, Fundamentals of Management, Pearson Education, 2009.
2. Dr. M. Sakthivel Murugan, Management Principles and Practices, New Age International (P) Ltd., 1st Edition.
3. YK Bhushan, Fundamentals of Business organization and Management, Sultan Chand and Sons, 16th Edition.

Reference Books:

1. Andrew DuBrin, Management Essentials, 9e, Cengage Learning, 2012.
2. VSP Rao, Management (Text & cases), Excel Books, 2nd Edition.
3. Management, James A.F. Stoner, R. Edward Freeman and Danial R. Gilbert, Prentice-Hall of India Pvt. Ltd., 6th Edition.
4. Industrial Engineering & Management, NVS Raju, Cengage Learning, 2013.

Online Resources:

Concept of Management and Evolution of Management Thought
http://nptel.ac.in/courses/122108038/9

Course Outcomes:

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

1. Associate the concept of Management in practical scenario for effective decision making.
2. Synthesize the preparation of effective plans in strategizing the decision making process.
3. Circumscribe the authority responsibility conduct in an organization.
4. Intuit the human resource management in an organization towards achievement of effectiveness.
5. Cognize the role of leader and motivation in the attainment of objectives of an organization.
6. Understand articulating techniques of controlling in the process of an organization.

III Year B.Tech. CSE (AI&ML) I-Semester	**L**	**T**	**P**	**C**
Course Code:	**3**	**-**	**-**	**3**

DATA VISUALIZATION

Prerequisites: - Nil-

Course Objectives:

1. To understand the basics and data pre-processing techniques of data visualization.
2. Learn various techniques about visualization of the data.
3. To learn about methods of visualizing distributions.
4. To implement visualization best practices and dashboard design.
5. To discuss visualizing associations among two or more quantitative variables.
6. To know about the visualization of time series and its trends.

UNIT 1: (~ 10 Lecture Hours)
Introduction to Visualization: The Visualization Process- The Computer Graphics Pipeline, The Visualization Pipeline, The Knowledge Discovery Pipeline, Data Foundations- Types of Data-Nominal, Ordinal, interval, Ratio scaled.
Data Pre-processing-1: Why Preprocess the Data? Descriptive Data Summarization- Measuring the Central Tendency, Measuring the Dispersion of Data- Range, Quartiles, Outliers, and Box plots, Variance and Standard Deviation, Graphic Displays of Basic Descriptive Data Summaries.

UNIT 2: (~ 9 Lecture Hours)
Data Pre-processing-2: Data Cleaning-Missing Values, Noisy Data- Outlier Detection, Correction and Removal, Data Cleaning as a Process, Data Imputation Techniques, Data Integration and Transformation – Data Integration, Data Transformation, Data Reduction - Attribute Subset Selection, Numerosity Reduction.
Visualizing Data: Mapping Data onto Aesthetics, Aesthetics and Types of Data, Scales Map Data Values onto Aesthetics, Visualizing Amounts: Bar Plots, Grouped and Stacked Bars, Dot Plots and Heat maps, Exploration of visualization tool-Tableau.

UNIT 3: (~ 9 Lecture Hours)
Visualizing Distributions: Histograms and Density Plots - Visualizing a Single Distribution, Visualizing Multiple Distributions at the Same Time.
Empirical Cumulative Distribution Functions and Q-Q Plots - Empirical Cumulative Distribution Functions, Highly Skewed Distributions, Quantile-Quantile Plots

UNIT 4: (~ 10 Lecture Hours)
Visualizing Many Distributions at Once: Visualizing Distributions along the Vertical Axis, Visualizing Distributions along the Horizontal Axis, Visualizing Associations among Two or More Quantitative Variables, Scatterplots, Correlograms Dimension Reduction, Paired Data.

UNIT 5: (~ 10 Lecture Hours)
Visualizing time series and other functions of an independent variable: Individual time series, Multiple time series and dose–response curves, Time series of two or more response variables.
Visualizing trends: Smoothing, Showing trends with a defined functional form, Detrending and time-series decomposition

Text Books:

1. Jiawei Han and Micheline Kamber, Data Mining- Concepts and Techniques-Morgan Kaufmann Publishers, Elsevier, 2nd Edition, 2006.
2. Daniel Keim, Georges Grinstein and Matthew O. Ward, Interactive Data Visualization Foundations, Techniques, and Applications, Natick, Massachusetts: A K Peters, Ltd.

Reference Books:

1. Claus O. Wilke, Fundamentals of Data Visualization, First Release Edition, Oreilly Publication.
2. Kieran Healy, Data Visualization: A Practical Introduction, 1st Edition, Princeton University Press.
3. Edward R. Tufte, The Visual Display of Quantitative Information, 2nd Edition, Graphics Press.

Online Resources:

1. https://clauswilke.com/dataviz/
2. https://bbooks.info/viewmore/interactive-data-visualization
3. https://www.coursera.org/specializations/data-visualization

Course Outcomes:

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

1. Understand basic computer knowledge in the visualization process and to pre-process the data.
2. Analyse the tools for creating, importing & exporting data and generate reports using different chart types.
3. Apply different methods of visualizing distributions.
4. Develop the empirical cumulative distribution functions and plots
5. Analyse various resources available on the visualizing associations among quantitative variables.
6. Visualization of time series data and its trends.

III Year B.Tech. CSE (AI&ML) I-Semester	**L**	**T**	**P**	**C**
Course Code:	**3**	**1**	**-**	**4**

COMPUTER NETWORKS

(Common to CSE (AI&ML), CSE (DS))

Prerequisites: Computer Organization and Architecture

Course Objectives:

1. Introduce the fundamental types of computer networks.
2. Demonstrate the TCP/IP and OSI models with merits and demerits.
3. Develop an understanding of modern network architecture from a design and performance perspective.
4. Introduce UDP and TCP Models along with application layer protocols.

UNIT 1: (~8 Lecture Hours)
Introduction: Uses of Computer Networks and Applications, Network hardware: Personal Area Networks, Local Area Networks, Metropolitan Area Networks, Wide Area Networks, Internetworks, Network software: Protocol Hierarchies, Design issues for the layers, Connection-Oriented Versus Connectionless Service, Service Primitives, The Relationship of Services to Protocols, Reference models, Example Networks: Internet.
Physical Layer: Guided Transmission Media: Twisted Pairs, Coaxial Cable, Fibber Optics, Wireless Transmission.

UNIT 2: (~10 Lecture Hours)
Data Link Layer: Design issues, Framing, Error detection and Correction, Elementary Data Link Protocols, Sliding Window Protocols.
Medium Access sub layer: The Channel Allocation Problem, Multiple Access Protocols: ALOHA, Carrier Sense Multiple Access Protocols, Collision Free Protocols, Ethernet, Data Link Layer Switching.

UNIT 3: (~10 Lecture Hours)
Network Layer: Design issues, Routing algorithms: The Optimality Principle ,Shortest Path Algorithm, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing, Broad Cast Routing, Multicast Routing, Congestion Control Algorithms: Approaches to Congestion Control, Traffic-Aware Routing, Admission Control, Quality of Service: Application Requirements, Traffic Shaping, Internetworking: Tunneling, The Network layer in the Internet: The IP Version 4 Protocol, IP Addresses, IP Versions 6, Internet Control Protocols.

UNIT 4: (~9 Lecture Hours)
Transport Layer: The Transport Service: Services provided to the Upper Layers, Transport Service Primitives, Elements of Transport Protocols: Addressing, The Internet Transport protocols: UDP and TCP protocols.

UNIT 5: (~8 Lecture Hours)
Application Layer: Domain Name System: The DNS Name Space, Domain Resource Records, Name Servers, Electronic Mail: Architecture and Services, The User Agent, Message Formats, Message Transfer, Final Delivery, WWW: Architectural Overview, Static Web Pages, Dynamic Web Pages and Web Applications, HTTP.

Text Books:

1. Computer Networks, Andrew S Tanenbaum, David. J. Wetherall, 5th Edition. Pearson Education/PHI.

Reference Books:

1. S.Keshav, An Engineering Approach to Computer Networks, 2nd Edition, Pearson Education.
2. Behrouz A. Forouzan, Data Communications and Networking, 5th Edition, TMH.

Online Resources:

1. http://www.mhhe.com/engcs/compsci/forouzan
2. https://onlinecourses.nptel.ac.in
3. https://www.coursera.org
4. https://www.mbit.edu.in/wp-content/uploads/2020/05/Computer-Networks-5th-Edition.pdf

Course Outcomes:

After completion of the course, students will be able to

1. Understand the basics of computer networks, networking devices and protocols.
2. Understand the functionalities of different layers of OSI and TCP/IP reference models.
3. Analyse the performance of data link layer and MAC layer protocols.
4. Acquire the knowledge of addressing and routing protocols and apply the same for different routing problems and applications.
5. Understand the services offered by transport entities and transport protocols.
6. Demonstrate various application layer protocols in real time.

III Year B.Tech. CSE (AI&ML) I-Semester **L T P C**
Course Code: **3 - - 3**

SOFTWARE ENGINEERING

(Professional Elective-1)
(Common to CSE (AI&ML), CSE (DS))

Prerequisites: -Nil-

Course Objectives:
1. Understand the software life cycle models.
2. Understand the importance of software development process.
3. Understand the importance of modeling and modeling languages.
4. Design and develop correct and robust software products.

UNIT 1: (~ 10 Lecture Hours)
Introduction to Software Engineering: The Evolving Role of Software, Changing Nature of Software, Software Myths.
A Generic view of process: Software Engineering- A Layered Technology, A Process Framework, The Capability Maturity Model Integration (CMMI), Process Patterns, Process Assessment, Personal and Team Process Models.
Process Models: The Waterfall Model, Incremental Process Models, Evolutionary Process Models, The Unified Process.

UNIT 2: (~ 9 Lecture Hours)
Software Requirements: Functional and Non-functional requirements, User Requirements, System Requirements, Interface Specification, The Software Requirements Document.
Requirements Engineering Process: Feasibility Studies, Requirements Elicitation and Analysis, Requirements Validation, Requirements Management.
System Models: Context Models, Behavioral Models, Data Models, Object Models, Structured Methods.

UNIT 3: (~ 9 Lecture Hours)
Design Engineering: Design Process and Design Quality, Design Concepts, The Design Model.
Creating an architectural design: Software Architecture, Data Design, Architectural Styles and Patterns, Architectural Design, Conceptual Model of UML, Basic Structural Modeling, Class Diagrams, Sequence Diagrams, Collaboration Diagrams, Use Case Diagrams, Component Diagrams.
Performing User Interface Design: Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, Design Evaluation.

UNIT 4: (~ 9 Lecture Hours)
Testing Strategies: A strategic approach to Software Testing, Test Strategies for Conventional Software, Black-Box and White-Box Testing, Validation Testing, System Testing, The Art of Debugging.
Product metrics: Software Quality, Metrics for Analysis Model, Metrics for Design Model, Metrics for Source Code, Metrics for Testing, Metrics for Maintenance.

UNIT 5: (~ 8 Lecture Hours)
Metrics for Process and Products: Software Measurement, Metrics for Software Quality.
Risk management: Reactive Vs Proactive Risk Strategies, Software Risks, Risk Identification, Risk Projection, Risk Refinement, RMMM, RMMM Plan.

Quality Management: Quality Concepts, Software Quality Assurance, Software Reviews, Formal Technical Reviews, Statistical Software Quality Assurance, Software Reliability, The ISO 9000 Quality Standards.

Text Books:

1. Roger S. Pressman, Software Engineering- A Practitioner's Approach, 6th Edition, Mc Graw Hill Companies Inc.
2. Sommerville, Software Engineering, 7th Edition, Pearson Education.

Reference Books:

1. James F. Peters, Witold Pedrycz and John Wiely, Software Engineering- An Engineering Approach, 1st Edition.
2. Grady Booch, James Rambaugh and Ivar Jacobson, The Unified Modelling Language User Guide, 2nd Edition, Pearson Education.
3. Waman S Jawadekar, Software Engineering Principles and Practice, The Mc Graw-Hill Companies, 2004.

Online Resources:

1. https://alison.com/courses/software-engineering
2. https://study.com/articles/List_of_Free_Online_Software_Engineering_Courses.html

Course Outcomes:

After completion of the course, students will be able to

1. Get acquaintance of basic software engineering methods and practices, process frame work and process models.
2. Emphasize on software requirements, SRS documents and project management.
3. Develop different system models that describe the functionality of the system.
4. Design and maintain efficient, reliable and cost effective software solutions and suitable software metrics.
5. Understand various testing approaches.
6. Emphasize on software measurement, software risks and quality control.

III Year B.Tech. CSE (AI&ML) I-Semester **L T P C**
Course Code: **3 - - 3**

DISTRIBUTED SYSTEMS

(Professional Elective-1)

Prerequisites: Operating Systems, Database Management Systems

Course Objectives:

1. To understand what and why a distributed system is.
2. To understand IPC, Group Communication & RPC Concepts.
3. To understand the DFS and different Name Services.
4. To understand theoretical concepts, namely, virtual time, agreement and consensus protocols.
5. To understand the concepts of Replication and transaction in distributed environment and associated concepts, namely, concurrency control, deadlocks and error recovery.

UNIT 1: (~ 9 Lecture Hours)
Characterization of Distributed Systems: Introduction, Examples of Distributed systems, Trends in distributed systems, Focus on resource sharing, Challenges, Case study: The World Wide Web.
System models: Introduction, Physical models, Architectural models, Fundamental models.

UNIT 2: (~ 9 Lecture Hours)
Inter Process Communication: Introduction, The API for the Internet Protocols, External data representation and marshalling, Multicast communication, Network virtualization: Overlay networks, Case Study: MPI.
Remote Invocation: Introduction, Request-reply protocols, Remote Procedure Call, Remote method invocation, Case study: Java RMI.

UNIT 3: (~ 8 Lecture Hours)
Distributed File Systems: Introduction, File Service architecture, Case study: SUN network file system and Andrew file system.
Name Services: Introduction, Name Services and the Domain Name System, Directory Services, Case study: The Global Name Service.

UNIT 4: (~ 10 Lecture Hours)
Time and Global States: Introduction, Clocks, Events and Process states, Synchronizing physical clocks, Logical time and logical clocks, Global states.
Coordination and Agreement: Introduction, Distributed mutual exclusion, Elections, Coordination and agreement in group communication, Consensus and related problems.

UNIT 5: (~ 10 Lecture Hours)
Distributed Transactions: Introduction, Flat and Nested Distributed Transactions, Atomic commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery.
Replication: Introduction, System model and the role of group communication, Fault-tolerant services, Transactions with replicated data, Case study: The gossip architecture.

Text Books:

1. George Coulouris, J Dollimore, Tim Kindberg and G Blair, Distributed Systems, Concepts and Design, 5th Edition, Pearson Education, 2012.

Reference Books:

1. Andrew S.Tanenbaum and Maarten VanSteen, Distributed systems- Principles and Paradigms, 2nd Edition, PHI.
2. Sukumar Ghosh, Distributed Systems-An Algorithm Approach, Chapman & Hall/CRC and Taylor & Fransis Group, 2007.

Online Resources:

1. https://www.smartzworld.com/notes/distributed-systems-notes-pdf-ds/
2. nptel.ac.in/courses/106106107
3. https://edutainmentzone.blogspot.com › Home › DS › Education
4. https://swayam.gov.in/course/3946-distributed-systems
5. https://www.coursera.org/courses?languages=en&query=distributedsystems
6. https://ce.guilan.ac.ir /images/other/soft/distribdystems.pdf

Course Outcomes:

After completion of the course, students will be able to

1. Understand the concepts, challenges of distributed system and various system models.
2. Analyze the establishment of Inter process communication and remote invocation between distributed systems.
3. Comprehend a distributed system with the features that support distributed file system and name services.
4. Apply virtual time, agreement and consensus protocols in distributed systems.
5. Apply and analyze the knowledge of distributed transactions and replication.
6. Familiarize with the design, implementation and other issues of distributed system.

III Year B.Tech. CSE (AI&ML) I-Semester **L T P C**
Course Code: **3 - - 3**

AUTOMATA AND COMPILER DESIGN

(Professional Elective-1)
(Common to CSE (AI&ML), CSE (DS))

Prerequisites: Programming for Problem Solving, Discrete Mathematics

Course Objectives:
1. Illustrating different phases of compilation.
2. Describe the steps and algorithms used by language translators.
3. Enumerating top down and bottom up parsing techniques used in compilation process.
4. Learning the effectiveness of optimization.
5. Introducing the syntax directed translation and type checking.
6. Understanding intermediate code generation.

UNIT 1: (~8 Lecture Hours**)**
Formal Languages and regular expressions: Languages, Regular Expressions, Finite Automata-DFA, NFA. Conversion of regular expression to NFA, NFA to DFA, minimization of DFA.
Introduction to Compilers: Translators, Compilers and Interpreters, Structure of a compiler, Cross compiler, Compiler construction tools.

UNIT 2: (~9 Lecture Hours**)**
Lexical Analysis –The Role of Lexical Analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens, The Lexical Analyzer Generator LEX.
Syntax Analysis: Role of Parser, Chomsky hierarchy of languages and Recognizers, Context Free Grammars, Derivations, Parse trees, Ambiguity.
Top Down Parsing: Recursive Descent Parsing, Predictive Parsing, LL(1) parsing, LL(k) Grammars.

UNIT 3: (~9 Lecture Hours**)**
Bottom Up Parsing: Reductions, Handle pruning, Shift Reduce Parsing, Conflicts during Shift-Reduce parsing, Introduction to LR Parsing SLR, More Powerful LR Parsers CLR and LALR, Using Ambiguous Grammars, The Parser Generator YACC.
Semantic Analysis: Syntax Directed Translation: Syntax Directed Definitions, Evaluation Orders for SDD's, Applications of Syntax Directed Translation.

UNIT 4: (~8 Lecture Hours**)**
Intermediate Code Generation: Variants of Syntax Trees, Three Address Code, Type expressions, Type equivalence, Type checking, Type conversion, Translation of simple statements and Control flow statements.
Run Time Environments: Storage Organization, Stack Allocation of Space, Access to Non local Data on the Stack, Heap Management

UNIT 5: (~9 Lecture Hours**)**
Code Optimization: Introduction, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Peephole optimization, Machine Independent Optimizations-The Principal Sources of Optimizations.
Code Generation: Issues in the Design of a Code Generator, Object code forms, A Simple Code Generator, Register Allocation and Assignment.

Text Books:

1. Aho Ullman, Monica S.Lam and Ravisethi, Compilers Principles, Techniques and Tools, 2nd Edition, Pearson Education.
2. Sipser, Introduction to Theory of computation. 2nd Edition, Thomson.

Reference Books:

1. Andrew W.Appel, Modern Compiler Construction in C, Cambridge University Press.
2. V.Raghavan, Principles of Compiler Design, TMH.
3. Kamala Krithivasan and Rama R, Introduction to Formal Languages and Automata Theory and Computation, Pearson.

Online Resources:

1. https://www.tutorialspoint.com › Compiler Design
2. http://openclassroom.stanford.edu/MainFolder/CoursePage. php? course = Compilers
3. https://onlinecourses.nptel.ac.in

Course Outcomes:

After completion of the course, students will be able to

1. Illustrate the concept of abstract machines and their power to recognize the languages.
2. Classify language classes, regular expressions, grammars and the relationship among them with the help of Chomsky hierarchy.
3. Demonstrate different parsing methods typically used in compilers.
4. Describe language translation techniques and their applications.
5. Illustrate storage allocation and access strategies of compilers.
6. Design techniques to improve the efficiency of a compiler and develop algorithms to generate code for target machine.

III Year B.Tech. CSE (AI&ML) I-Semester **L T P C**
Course Code: **- - 2 1**

EMPLOYABILITY AND SOFT SKILLS LAB
(Common to CSE, CSE (AI&ML), CSE (DS), CST, ETE, EEE, ECE& IT)

Prerequisites: Nil

Course Objectives:
1. To address various challenges of communication as well as behavioural traits faced by individuals at workplace and organizations through case studies and interactions.
2. To help the students engage with other members confidently through various discussions and presentations.
3. To help the students write business documents and generate content effectively.
4. To enhance soft skills among the students and to enable them to understand its impact on employability.
5. To equip the students with career planning and employability.

UNIT 1: (~02 lecture hours and 4 practical sessions)
INTERPERSONAL AND INTRAPERSONAL COMMUNICATION SKILLS
1. *Factors impacting Communication Skills:*Self awareness – Self analysis – Self appraisal – Self esteem.
2. Barriers and Factors impacting Interpersonal and Intrapersonal communication, both verbal and non –verbal communication.
3. Student presentations through **SWOT** Analysis.

Unit Objective: *To develop confidence and ability to communicate effectively overcoming emotional and psychological barriers through* ***SWOT*** *Analysis.*

UNIT 2: (~02 lecture hours and 6 practical sessions)
TEAM BUILDING AND GROUP DYNAMICS
1. Factors influencing group behavior – Process of group development: *Forming, Storming, Norming, Performing, Adjourning* – Group Members individual roles and responsibilities.
2. Critical thinking and logical reasoning through SPELT Analysis – Six Thinking Hats and Mind Maps.
3. Student presentations and performance through group activities.

Unit Objective: *To engage in peer interaction for exchange of ideas and to empower the individuals to contribute to common goals of the team build.*

UNIT 3: (~02 lecture hours and 4 practical sessions)
WRITTEN COMMUNICATION SKILLS
1. *Processes in writing:*Brainstorming –Drafting – Revising – Editing - Proof Reading - Final draft.
2. *Prerequisites for Effective Writing:*Lexical Resource: *Vocabulary in context* – Grammatical function in use: *Syntax and accuracy* - Researching - Note-making – Support visuals – Procedures and processes – Structuring and Formatting – IT skills.
3. Writing tasks assigned in the written format of E-mail correspondence – Covering letter and Resume building – Technical Report Writing – Developing a Portfolio.

Unit Objective: *To develop written expression of thought and provide learners opportunities to explore ideas and to build connections between content areas.*

UNIT 4: (~02 lecture hours and 4 practical sessions)

PRESENTATION SKILLS

1. *Processes in presentation:*Analysing the audience -Selecting a topic -Defining the objective - Preparing the structure - Practicing and Delivering.
2. *Prerequisites for Effective Presentation:*Content development – Researching – Note-taking – Drafting –Organizing – Formatting – Structuring – Visual support – IT Skills
3. Presentations are done through Image description – Poster Presentation – Pecha kucha.

Unit Objective: *To overcome anxiety, fear and nervousness when making a technical presentation using effective delivery methods and techniques.*

UNIT 5: (~02 lecture hours and 4 practical sessions)

GROUP DISCUSSIONS AND INTERVIEW SKILLS

1. *Prerequisites for Group Discussion* – Definition, Rules, Types – *Topical issues, Case studies, Abstract topics*–Evaluation criteria – *Content, Analytical and Reasoning skills, Creativity, Organisation skills, Communication skills, Listening skills, Leadership skills, Body language, Group behavior.*
2. *Prerequisites for Interview Skills* – Researching companies, Reading job descriptions, Using appropriate language, Using **STAR** method to answer interview questions –***S****- Situation, background setting and context****T****- Task or Target, specifics of what's required, when, where, who* ***A****- Action, what you did, skills used, behaviours, characteristics* ***R****- Result – outcome, what happened? How valuable the learning was?*
3. Student presentations and performance through Group Discussions and Mock Interviews.

Unit Objective: *To provide insights on the learner's thinking skills, listening abilities and how they communicate their thoughts, views and opinions during one-to many and one – on-one interactions.*

Reference Books:

1. T.M.Farhathullah, *Communication Skills for Technical Students*, Orient BlackSwan Pvt. Ltd., 2002.
2. Sangeetha Sharma and Binod Mishra, *Communication Skills for Engineers and Scientists*, PH1 Learning Pvt.Ltd., 2011.
3. Sanjay Kumar and Pushp Lata, *Communication Skills,* Oxford Higher Education, 2nd Education 2015.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc19_hs22/preview
2. https://onlinecourses.nptel.ac.in/noc19_hs04/preview

Course Outcomes:

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

1. Apply basic communication skills (LSRW) in work-related situations.
2. Acquire, organize, interpret and evaluate information for effective communications within a group.
3. Demonstrate the ability to combine ideas or information in new ways and present information on guided and structured format.
4. Make decisions and solve problems by specifying goals, identifying resources and constraints and evaluating results.
5. Display personal qualities such as responsibility, self-management, self-confidence, ethical behaviour and respect for self and others.
6. Learn to work cooperatively with people of diverse backgrounds and abilities, identify group's goals and values and contribute to a group process with ideas, suggestions and efforts.

III Year B.Tech. CSE (AI&ML) I-Semester **L T P C**
Course Code: **- - 3 1.5**

COMPUTER NETWORKS LAB

(Common to CSE (AI&ML), CSE (DS))

Prerequisites: Programming for Problem Solving

Course Objectives:

1. Understand the functionalities of various layers of OSI model.
2. Analyse flow control mechanisms for data link layer.
3. Implement various routing algorithms to compute the shortest distance.
4. Understand the network simulator environment.

List of Experiments:

Week 1:
Implement the data link layer framing methods such as character count, character-stuffing and bit stuffing.

Week 2:
Write a program to compute CRC code for the polynomials CRC-12, CRC-16 and CRC CCIP.

Week 3:
Develop a simple data link layer that performs the flow control using the sliding window protocol, and loss recovery using the Go-Back-N mechanism.

Week 4:
Implement Dijsktra's algorithm to compute the shortest path through a network.

Week 5:
Take an example subnet of hosts and obtain a broadcast tree for the subnet.

Week 6:
Implement distance vector routing algorithm for obtaining routing tables at each node.

Week 7:
Write a program for congestion control using Leaky bucket algorithm.

Week 8:
Write a program for frame sorting technique used in buffers.

Week 9:
Install Wireshark and perform the following using Wireshark

a. Packet Capture Using Wire shark
b. Starting Wire shark
c. Viewing Captured Traffic
d. Analysis and Statistics & Filters.

Week 10:
How to run Nmap scan

Week 11:
Operating System Detection using Nmap

Week 12:
Do the following using NS2 Simulator
a. NS2 Simulator-Introduction
b. Simulate to Find the Number of Packets Dropped
c. Simulate to Find the Number of Packets Dropped by TCP/UDP

Week 13:
a. Simulate to Find the Number of Packets Dropped due to Congestion.
b. Simulate to Compare Data Rate& Throughput.
c. Simulate to Plot Congestion for Different Source/Destination.
d. Simulate to Determine the Performance with respect to Transmission of Packets.

Week 14:
Implement Linux Network Configuration Commands.
a. Configuring NIC's IP address.
b. Determining IP address and MAC address using if-config command.
c. Changing IP address using if-config command.

Text Books:
1. Andrew S Tanenbaum, Computer Networks, 5th Edition, Pearson Education.

Reference Books:
1. Behrouz A.Forouzan, Data Communications and Networking, 5th Edition, TMH, 2013.

Online Resources:
1. https://onlinecourses.nptel.ac.in/noc20_cs23/preview
2. https://www.varonis.com/blog/how-to-use-wireshark/
3. https://tools.kali.org/information-gathering/nmap
4. http://intronetworks.cs.luc.edu/current/html/ns2.html

Course Outcomes:
After completion of the course, students will be able to
1. Implement data link layer functions such as framing methods.
2. Demonstrate error detection at the data link layer.
3. Ability to apply appropriate algorithm for the finding of shortest route.
4. Ability to configure the routing table.
5. Implement the congestion control mechanisms.
6. Use the different network tools to analyse the performance.

III Year B.Tech. CSE (AI&ML) I-Semester **L T P C**
Course Code: **- - 3 1.5**

DATA VISUALIZATION LAB

Prerequisites: -Nil-

Course Objectives:
1. To understand the basics of data visualization using Tableau.
2. Learn various techniques about visualization of the data.
3. To learn the methods for visualization of frequency distribution.
4. To implement various visualization applications.
5. To design the visualization of structured and unstructured data.

List of Experiments using Tableau

Week 1: Basics of Data Visualization Tool Tableau: Basics of Tableau, Measures and Dimensions.

Week 2: Plotting data using Tableau: Types of charts in Tableau, selection of a chart type/data visualization, Histogram and Heat Map, Story Points.

Week 3: Visualization of Data using Tools/Libraries: Interactive Dashboards.

Week 4: Statistical Analysis using Tableau
a. Multivariate Analysis
b. Principal Component Analysis
c. Linear Discriminant Analysis
d. Correlation and regression

Week 5: Analysis of variance, Trend line modeling and Forecasting**.**

Week 6: Business Case Studies of Data Visualization
a. Financial analysis using Clustering
b. Segmentation of Mall Customers using Clustering Analysis
c. Segmentations of Bank Loan Applicants

Week 7: Time-series analysis and Visualization on stock market data.

Week 8 & 9: Visualization of various massive datasets
a. Finance
b. Healthcare
c. Census
d. Geospatial, Tableau Public (to share Data Visualizations Online).

Week 10: Visualization on Streaming dataset- Weather forecasting.

Week 11: Visualization of structured data: Market-Basket Data analysis

Week 12: Visualization of unstructured data: Web data analytics.

Text books:
1. Daniel Keim, Georges Grinstein and Matthew O. Ward, Interactive Data Visualization Foundations, Techniques, and Applications, Natick, Massachusetts: A K Peters, Ltd.
2. Claus O. Wilke, Fundamentals of Data Visualization, 1st Edition, Oreilly Publication.

Reference books:

1. Kieran Healy, Data Visualization: A Practical Introduction, 1st Edition, Princeton University Press.
2. Edward R. Tufte, The Visual Display of Quantitative Information, 2nd Edition, Graphics Press.

Online Resources:

1. https://data-flair.training/blogs/tableau-tutorial
2. https://www.educba.com/data-visualization-with-tableau
3. https://www.coursera.org/specializations/data-visualization

Course Outcomes:

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

1. Understand the basics of data visualization using Tableau.
2. Design the data and generate reports using different chart types.
3. Apply different methods for visualization of frequency distribution.
4. Develop the statistical analysis of data visualization.
5. Analyze various visualization applications.
6. Design the visualization of structured and unstructured data.

III Year B.Tech. CSE (AI&ML) II-Semester	**L**	**T**	**P**	**C**
Course Code:	**3**	**-**	**-**	**3**

DESIGN AND ANALYSIS OF ALGORITHMS

(Common to CSE (AI&ML), CSE (DS))

Prerequisites: Programming for Problem Solving, Data Structures using C

Course Objectives:

1. Analyze the asymptotic performance of algorithms.
2. Apply important algorithmic design paradigms and methods of analysis.
3. Synthesize efficient algorithms in common engineering design situations.
4. Classify and categorize the problems into P and NP.

UNIT 1: (~8 Lecture Hours)
Introduction: Characteristics of algorithm, Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior, Performance measurements of Algorithm- Time and space trade-offs, Analysis of recursive algorithms through recurrence relations- Substitution method and Masters Method, Fundamental Algorithmic strategies-General Methods.
Divide and conquer - Binary search, Merge sort, Quick sort, Strassen's Matrix Multiplication.

UNIT 2: (~10 Lecture Hours)
Disjoint Sets: Disjoint set operations, union and find algorithms, connected components and bi-connected components.
Greedy method- Knapsack problem, Job sequencing with deadlines, Minimum cost spanning trees, Single source shortest path problem.

UNIT 3: (~10 Lecture Hours)
Dynamic Programming- Chained matrix multiplication, All pairs shortest path problem, Optimal binary search trees, 0/1 knapsack problem, Reliability design, Traveling sales person problem.

UNIT 4: (~10 Lecture Hours)
Backtracking- The N-queen problem, Sum of Subsets problem, Graph Coloring, Hamiltonian cycles.
Branch and Bound- 0/1 Knapsack problem, LC Branch and Bound solution, FIFO Branch and Bound solution, Travelling sales person problem.

UNIT 5: (~8 Lecture Hours)
Approximation Algorithms - The vertex-cover problem, the travelling- salesman problem, the subset-sum problem.
NP-Hard and NP-Complete problems - Basic concepts, Non-deterministic algorithms, NP - Hard and NP- Complete classes, Cook's theorem.

Text Books:

1. Ellis Horowitz, Sartaj Sahni and S. Rajasekaran, Fundamentals of Computer Algorithms, 2nd Edition, Universities Press.
2. Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, Introduction to Algorithms, 3rd Edition, MIT Press/McGraw-Hill.

Reference Books:

1. M. T. Goodrich and R.Tomassia, Algorithm Design: Foundations, Analysis and Internet examples, John Wiley and sons.
2. S. Sridhar, Design and Analysis of Algorithms, Oxford Univ. Press.
3. Aho, Ullman and Hopcroft, Design and Analysis of algorithms, Pearson Education.
4. P.H. Dave and H.B. Dave, Design and Analysis of Algorithms, 2nd Edition Pearson Education.

Online Resources:

1. http://nptel.ac.in/courses/106101060/
2. https://www.udemy.com/course/design-and-analysis-of-algorithm-/

Course Outcomes:

After completion of the course, students will be able to

1. Apply design principles and concepts to algorithms and analyze the time and space complexities.
2. Apply different designing methods for development of algorithms to realistic problems, such as divide and conquer, greedy.
3. Develop the dynamic programming algorithms, and analyze it to determine its computational complexity.
4. Implement Branch and Bound, Back Tracking Techniques to solve problems.
5. To compare the advantages and limitations of different strategies on a real world problem instance.
6. Formulate Non-deterministic algorithms for NP hard and NP complete problems and explain what an approximation algorithm is.

III Year B.Tech. CSE (AI&ML) II-Semester **L T P C**
Course Code: **3 - - 3**

INTRODUCTION TO MACHINE LEARNING

(Common to CSE (AI&ML), CSE (DS))

Prerequisites: Probability and Statistics, Data Structures using C

Course Objectives:

1. To introduce students to the basic concepts of Machine Learning.
2. To become familiar with regression and SVM.
3. To study the Decision tree and Bayesian Classifiers.
4. To understand instance-based learning and clustering techniques
5. To learn Genetic algorithms and reinforcement learning.

UNIT 1: (~ 8 Lecture Hours)
Introduction to Machine Learning: What is Machine Learning, Examples of Machine Learning Applications, Types of Machine Learning systems-Supervised learning, Unsupervised learning, Reinforcement learning, Learning a class from examples.
Concept learning and the general to specific ordering – Introduction, A concept learning task, Concept learning as search, find-S, Version spaces and the candidate elimination algorithm.

UNIT 2: (~ 8 Lecture Hours)
Parametric methods: Introduction, Maximum Likelihood Estimation, Evaluating an Estimator: Bias and Variance, The Bayes' Estimator, Parametric Classification, Regression.
Support vector machines: Introduction, Optimal hyperplane for linearly separable patterns, Quadratic optimization for finding the optimal hyperplane, Statistical properties of the optimal hyperplane, Optimal hyperplane for non-separable patterns, SVM non-linear regression.

UNIT 3: (~ 10 Lecture Hours)
Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, Bayes optimal classifier, Naïve Bayes classifier.
Decision Tree Learning: Introduction, Decision tree representation, Appropriate problems for decision tree learning, The basic decision tree learning algorithm, Hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning.

UNIT 4: (~ 9 Lecture Hours)
Instance-based learning: Introduction, KNN learning, Distance weighted NN algorithm, Remarks on KNN Algorithm.
Unsupervised learning: Introduction, K-means clustering technique, Hierarchical clustering, Choosing the number of clusters.

UNIT 5: (~ 8 Lecture Hours)
Reinforcement Learning: Introduction, The learning task, Q learning, Nondeterministic rewards and actions.
Genetic Algorithms: Motivation, Genetic algorithms, An illustrative example, Hypothesis space search, Genetic programming.

Text Books:

1. Ethem Alpaydin, Introduction to Machine Learning, 2nd Edition, MIT Press, 2010.
2. Tom Mitchell, Machine Learning, McGraw-Hill, 1997.

Reference Books:

1. Simon Haykin, Neural Networks a Comprehensive Foundations, PHI Edition.
2. Aurelien Geron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, O'Reilly Media, Inc, 2019.
3. Giuseppe Bonaccorso, Machine Learning Algorithms, 2nd Edition, Packt, 2018.
4. Laurene Fausett, Fundamentals of Neural Networks, Architectures, Algorithms and Applications, Pearson Education, 2008.

Online Resources:

1. http://www.holehouse.org/mlclass/index.html.
2. https://www.udacity.com/course/intro-to-machine-learning--ud120.
3. https://onlinecourses.nptel.ac.in/noc21_cs85/preview.

Course Outcomes:

After completion of the course, students will be able to

1. Understand complexity of Machine Learning algorithms and their limitations.
2. Explore regression and apply SVM classifiers for any real scenario.
3. Create solutions with Decision trees and Bayesian classifiers for various business problems.
4. Implement the instance-based learning and clustering techniques for suitable applications.
5. Apply Genetic algorithms and Reinforcement learning on real-world applications.
6. Design application using real datasets and evaluate the performance of the different algorithms.

III Year B.Tech. CSE (AI&ML) II-Semester **L T P C**
Course Code: **3 - - 3**

DATA MINING AND PREDICTIVE ANALYTICS

Prerequisites: Database Management Systems

Course Objectives:
1. Understand the fundamental concepts of data mining, data pre-processing techniques.
2. Characterize the kinds of patterns that can be discovered by association rule mining.
3. Learn various classification techniques in data mining.
4. Gain knowledge on advanced classification techniques and accuracy measures.
5. Implement various clustering techniques.
6. Advice on when and how to use each model. Also learn how to combine two or more models to improve prediction.

UNIT 1: (~ 9 Lecture Hours)
Introduction to Data Mining: Introduction, What is Data Mining, Data Mining Functionalities, Classification of Data Mining systems, Data Mining Task Primitives, Major issues in Data Mining.
Data Pre-processing: Need for Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization and Concept Hierarchy Generation.

UNIT 2: (~ 9 Lecture Hours)

Mining Frequent Patterns, Associations, and Correlations: Basic Concepts, Efficient and Scalable Frequent Item set Mining Methods, Mining various kinds of Association Rules, From Association Mining to Correlation Analysis.

UNIT 3: (~ 10 Lecture Hours)
Classification & Model development: Model Development Techniques: **Decision Trees**- Introduction and Requirements for Using Decision Trees, Classification and Regression Trees, C4.5 Algorithm, **Simple Linear Regression**- An Example of Simple Linear Regression, Dangers of Extrapolation, Usefulness of the Regression, The Coefficient of Determination, Standard Error of the Estimate, **Logistic Regression**- Simple Example of Logistic Regression, Maximum Likelihood Estimation, **Naïve Bayes and Bayesian Networks**- Bayesian Approach, Naïve Bayes Classification, Bayesian Belief Networks.

UNIT 4: (~ 10 Lecture Hours)
Model Evaluation & Model Performance Techniques: Model Evaluation Techniques for Description Task, Prediction Tasks and Model Evaluation Measures: Accuracy, Overall Error Rate, Sensitivity, Specificity, False Positive Rate and False Negative Rate.
Ensemble Methods: Bagging and Boosting-Rationale for Using an Ensemble of Classification Models, Bias, Variance, and Noise, When to apply and not to apply Bagging, Bagging, Boosting.

UNIT 5: (~ 9 Lecture Hours)

Cluster Analysis: Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Clustering-K-Means, Hierarchical Clustering-Agglomerative and Divisive, Density-Based Clustering-DBSCAN, Grid-Based Clustering-STING.

Outlier Analysis and Detection methods-Statistical Distribution-Based Outlier Detection, Distance-Based Outlier Detection, Density-Based Local Outlier Detection and Deviation-Based Outlier Detection.

Text Books:

1. Jiawei Han and Michelinen Kamber, Data Mining-Concepts and Techniques, 2nd Edition, Morgan Kaufmann Publishers, Elsevier, 2006.
2. Daniel T. Larose and Chantal T. Larose, Data Mining and Predictive Analysis, Wiley publisher, 2nd Edition, 2015.

Reference Books:

1. Pang-Ning Tan, Vipin Kumar and Michael Steinbanch, Introduction to Data Mining, 1st Edition, Pearson Education, 2016.
2. Arun K Pujari, Data Mining Techniques, 3rd Edition, Universities Press, 2005.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc20_cs12/preview.
2. http://ccs1.hnue.edu.vn/hungtd/DM2012/DataMining_BOOK.pdf
3. https://www.coursera.org/specializations/data-mining

Course Outcomes:

After completion of the course, students will be able to

1. Understand the fundamental concepts of data mining to pre-process the data.
2. Formulate the association rules using different Algorithms.
3. Understand different classification techniques.
4. Evaluate the advanced classification techniques and accuracy measures.
5. Identify and understand different clustering techniques.
6. Evaluate and implement predictive models for a various business application.

III Year B.Tech. CSE (AI&ML) II-Semester **L T P C**
Course Code **3 - - 3**

WEB DEVELOPMENT TECHNOLOGIES

(Professional Elective-2)
(Common to CSE (AI&ML), CSE (DS))

Prerequisites: IT Workshop and Python Programming Lab

Course Objectives:

1. To introduce client and server-side scripting.
2. To introduce XML and processing of XML Data with Java.
3. To gain knowledge in servlets and JSPs for web development.
4. To understand the basics of python libraries of Django and Flask.

UNIT 1: (~12 Lecture Hours)
Client-Side Scripting: Introduction to Java Script, variables, functions, Event handling, DOM, Form validation.
XML: Introduction to XML, Defining XML tags, their attributes and values, Document Type Definition, XML Schemas, Document Object Model, XHTML Parsing XML Data - DOM and SAX Parsers in java.

UNIT 2: (~9 Lecture Hours)
Introduction to Servlet: Lifecycle of a Servlet, deploying a servlet, The Servlet API, Reading Servlet parameters, Reading Initialization parameters, Handling Http Request & Responses, Using Cookies and Sessions.
JDBC: Introduction to JDBC drivers, Types of Drivers, java.sql package, connecting to a database using JDBC, manipulating data in database.

UNIT 3: (~9 Lecture Hours)
Introduction to JSP: The Anatomy of a JSP Page, JSP Processing, Declarations, Directives, Expressions, implicit objects, Cookies and session for session tracking in JSP, connecting to database in JSP.
Introduction to Django: MVC framework, Creating Django project- installing Django, creating an application, Routing in Django, Regular expressions, Creating URL, View and testing of application.

UNIT 4: (~9 Lecture Hours)
Django Templates: Displaying template, Injecting the data from the view to the template, creating dynamic templates, integrating variables in templates, filters, extending templates, using static files in templates, working with models- Databases and Django, creating simple models, Getting a model's data with Querysets, Django forms.

UNIT 5: (~9 Lecture Hours)
Flask: Introduction, Basic application structure, Templates, web forms, Database connectivity-SQL, Deployment.

Text Books:

1. Uttam K. Roy, Web Technologies, OXFORD University press, 2010.
2. Arun Ravindran, Samuel Dauzon and Aidas Bendoraitis, Django: Web Development with Python, Packt Publishing, 2017.
3. Miguel Grinberg, Flask Web Development, 2nd Edition, O'Reilly Media, Inc. 2018.

Reference Books:

1. Robert S. Sebesta, Programming World Wide Web, 4th Edition, Pearson Education, 2014.
2. Hans Bergsten, Java Server pages, O'Reilly Media, 2009.
3. Mike McMillan, Web Programming with Python, Infinite Skills, 2012.

Online Resources:

1. https://docs.djangoproject.com
2. https://flask.palletsprojects.com

Course Outcomes:

After completion of course, students will be able to

1. Develop a dynamic webpage using DHTML, DOM and java script.
2. Write a well-formed / valid XML document and understand how to parse and use XML data with java.
3. Write a server-side java application called Servlet, JSP with database connectivity.
4. Understand Django framework.
5. Design applications using Django templates.
6. Create and deploy web applications using Flask.

III Year B.Tech. CSE (AI&ML) II-Semester **L T P C**
Course Code **3 - - 3**

COMPUTER VISION AND PATTERN RECOGNITION

(Professional Elective-2)
(Common to CSE (AI&ML), CSE (DS))

Prerequisites: Linear Algebra and Multivariable Calculus

Course Objectives:

1. Familiarize the students with both the theoretical and practical aspects of computing with images.
2. Understand the foundation of image formation and analysis.
3. Feature extraction using Histogram Processing, Color, Edges and shape.
4. Applying basic mathematical morphology concepts and segmentation.
5. Identifying various patterns using classification and clustering techniques.

UNIT 1: (~ 10 Lecture Hours)
Image Processing: Fundamental steps in Digital image processing, Components of an image processing system, The Image model and Image acquisition, Image sampling and quantization, Basic relationships between pixels.
Image Enhancement in the Spatial Domain: Basic grey-level transformation, histogram processing, Enhancement using arithmetic and logic operators.

UNIT 2: (~ 9 Lecture Hours)
Spatial Filtering: Fundamentals of spatial filtering, smoothing and sharpening spatial filters, combining the spatial enhancement methods,
Color Image Processing: Color Fundamentals and Color models-The RGB Color Model, The CMY and CMYK Color Models, The HSI Color Model
Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transformation, Basic Morphological Algorithms: Hole filling, connected components, Thinning and skeletons.

UNIT 3: (~ 9 Lecture Hours)
Image Segmentation: Fundamentals, Point, line and Edge detection, Thresholding, Region based segmentation, Segmentation Using Morphological Watersheds.
Image Compression: Fundamentals- Coding Redundancy, Spatial and Temporal Redundancy, Irrelevant Information, Image Compression Models. Some Basic Compression Methods: Lossless and Lossy Compression, Huffman Coding, Arithmetic Coding, Run-Length coding, Bit-Plane Coding.

UNIT 4: (~ 9 Lecture Hours)
Pattern Recognition: Introduction, Data Structures for Pattern Representation, Feature Extraction- Principal Component Analysis (PCA), Feature Selection- Exhaustive Search, Branch and Bound Search, Selection of Best Individual Features, Sequential Selection, Classification- k Nearest Neighbour (kNN) Algorithm, Bayes Classifier - Bayes Theorem, Minimum error rate classifier, Naive Bayes Classifier, Bayesian Belief Network.

UNIT 5 (~ 8 Lecture Hours)
Clustering In Patterns: The Importance of Clustering, Hierarchical Algorithms, Divisive Clustering, Agglomerative Clustering, Partitional Clustering- K-Means Algorithm, Soft Partitioning, Clustering Large Datasets.
Recent Trends in Pattern Recognition: Hand written Digit Recognition, Emotion Recognition.

Text Books:

1. R C Gonzalez and R E woods, Digital Image Processing, 3rd Edition, Addison Pearson.
2. V Susheela Devi and M Narasimha Murthy, Pattern Recognition- An Introduction, Universities Press.

Reference Books:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, 1st Edition, Springer.
2. Robert B. Fisher et al, Dictionary of Computer Vision and Image Processing, 2nd Edition.
3. Julus T. Tou, and Rafel C. Gonzalez, Pattern recognition Principles, Addision-Wesly Publishing Company.
4. Duda R. O., Hart P. E. and Stork D. G., Pattern Classification, 2nd Edition, John Wiley & Sons, 2003.

Online Resources:

1. https://computervisiononline.com
2. http://groups.csail.mit.edu/vision/courses/6.869/materials.html
3. https://in.udacity.com/course/introduction-to-computer-vision--ud810
4. https://www.class-central.com/course/coursera-deep-learning-in-computer-vision-9608

Course Outcomes:

After completion of the course, students will be able to

1. Understand fundamental image processing techniques required for computer vision.
2. Extract features using Histogram Processing, Colour and Shape.
3. Apply basic morphological operations.
4. Employ various edge detection, image compression techniques.
5. Gain practical knowledge and skills about pattern classification techniques.
6. Evaluate various pattern clustering techniques.

III Year B.Tech. CSE (AI&ML) II-Semester **L T P C**
Course Code: **3 - - 3**

INTERNET OF THINGS AND APPLICATIONS

(Professional Elective-2)
(Common to CSE (AI&ML), CSE (DS))

Prerequisites: Computer Organization and Architecture

Course Objectives:
1. To introduce the IoT terminology, technology and its applications.
2. To present the concept of M2M (machine to machine) with necessary protocols.
3. To describe the Raspberry Pi platform, that is widely used in IoT applications.
4. To introduce the implementation of web-based services on IoT devices.
5. To impart the knowledge about Cloud offerings for IoT.

UNIT 1: (~9 Lecture Hours)
Introduction to Internet of Things – Definition and Characteristics of IoT, Physical Design of IoT-IoT Protocols, IoT Communication Models, IoT Communication APIs and IoT enabling Technologies.

UNIT 2: (~9 Lecture Hours)
IoT and M2M – Introduction, M2M, Difference between IoT and M2M, Difference between SDN and NFV for IoT.
IoT System Management with NETCONF-YANG – Need for IoT System Management, SNMP, Network Operator Requirements, NETCONF, YANG, IoT System Management with NETCONF-YANG.

UNIT 3: (~9 Lecture Hours)
Developing Internet of Things – Introduction, IoT Platforms Design Methodology, Case Study on IoT System for Weather Monitoring, Motivation for Using Python.

UNIT 4: (~9 Lecture Hours)
IoT Physical Devices and Endpoints – Introduction to Raspberry Pi- Interfaces (serial, SPI, I2C) Programming-Python program with Raspberry Pi with focus of interfacing external gadgets, Controlling Output and Reading input from pins.

UNIT 5: (~9 Lecture Hours)
IoT Physical Servers and Cloud Offerings – Introduction to Cloud Storage models and communication APIs, Web server for IoT, Cloud for IoT, Python web application framework.

Text Books:
1. Arshdeep Bahga and Vijay Madisetti, Internet of Things - A Hands-on Approach, Universities Press, ISBN: 9788173719547, 2015.
2. Matt Richardson and Shawn Wallace, Getting Started with Raspberry Pi, O'Reilly (SPD), ISBN: 9789350239759, 2014.

Reference Books:
1. David, Hanes and Salgueiro Gonzalo, IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things, Pearson 2017.
2. Dirk Slama and Frank Puhlmann, Enterprise IoT: Strategies and Best Practices for Connected Products and Services, 2015.
3. Rajkamal, Internet of Things: Architecture, Design Principles and Applications, McGraw Hill Higher Education.

Online Resources:

1. https://www.tutorialspoint.com.
2. https://www.edureka.co.
3. https://www.onlinecourses.nptel.ac.in

Course Outcomes:

After completion of the course, students will be able to

1. Understand the IoT Systems.
2. Learn the concept of M2M (machine to machine) with necessary protocols.
3. Create programs for Raspberry Pi interfaces.
4. Develop programs using python programming language in IoT devices.
5. Identify IoT Systems for communication using Cloud.
6. Apply IoT principles for domain specific applications.

III Year B.Tech. CSE (AI&ML) II-Semester **L T P C**
Course Code: **- - 4 2**

MACHINE LEARNING AND PREDICTIVE ANALYTICS LAB

Prerequisites: IT Workshop and Python Programming Lab, Database Management Systems

Course Objectives:

1. Identify machine learning problems corresponding to different applications.
2. Develop proficiency in applying scientific method to build machine learning algorithms.
3. Design and evaluate the performance of various machine learning models.
4. Provide practical exposure of the classification and clustering algorithms.
5. Develop Ensemble Techniques to perform prediction.
6. Intended to provide practical exposure of the Regression Techniques.

List of Programs:

Week 1: Create a text file of any real dataset and perform an exploratory data analysis.

Week 2: Implement data cleaning, data integration and data reduction methods.

Week 3: Implement Apriori algorithm and generate strong association rules on German_credit dataset with Minimum Support 60% and Minimum Confidence 80%.

Week 4: Implement Decision tree for classification on any given data set by using Information Gain and gain ratio measures and generate the confusion matrix with accuracy.

Week 5: Implement Support Vector Machine Classification of any given data set. Compute the accuracy of the classifier by considering few test data sets.

Week 6: Implement the naïve Bayesian classifier and compute the accuracy, precision and recall of the classifier, considering appropriate data set.

Week 7: Implement k-Nearest Neighbor algorithm to classify any given data set for different values of k. Tabulate the results for true positives and True negatives.

Week 8: Implement simple linear and multiple linear Regression algorithms to fit data points.
Select appropriate data set for your experiment and draw graphs.

Week 9: Implement Logistic Regression method on iris dataset, report accuracy and analyze confusion matrix results.

Week 10: Apply k-means clustering algorithm to cluster a set of data stored in a text file. Use the same data set for clustering using Hierarchical algorithm. Compare the results of these two algorithms and comment on the quality of clustering.

Week 11: Implement any two ensemble classifiers and compare the accuracy with traditional machine learning algorithms.

Week 12: Implement suitable machine learning and predictive methods on the following real datasets after performing appropriate data preprocessing techniques.

(i) Supermarket (ii) Weather (iii) Airlines
(iv) Breast Cancer (v) Forest fires

Text Books:

1. Tom M. Mitchell, Machine Learning, Mc Graw Hill Education, 1997.
2. Sebastian Raschka, Python Machine Learning, PACKT Publishing, 2015.
3. Ian. H. Witten and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, 2nd Edition, Elsevier Publication, 2005.
4. Jiawei Han, Micheline Kamber and Jian Pei, Data Mining Concepts and Techniques, Morgan Kaufmann Publishers, 3rd Edition, 2012.

Reference Books:

1. Stephen Marsland, Machine Learning - An Algorithmic Perspective, CRC Press, 2009.
2. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.

Online Resources:

1. https://www.w3schools.com/
2. http://www.cs.cmu.edu/~tom/
3. http://www.holehouse.org/mlclass/

Course Outcomes:

After completion of the course, students will be able to

1. Understand the logic and underlying mathematics behind basic supervised learning algorithms.
2. Design and evaluate unsupervised models through python in built functions
3. Compare the performance of machine learning algorithms using benchmark data sets.
4. Design various classification algorithms for data mining.
5. Implement clustering algorithms for data mining.
6. Develop Ensemble Techniques to perform Prediction.

III Year B.Tech. CSE (AI&ML) II-Semester **L T P C**
Course Code: **- - 2 1**

WEB DEVELOPMENT TECHNOLOGIES LAB
(Professional Elective-2)
(Common to CSE (AI&ML), CSE (DS))

Prerequisites: IT Workshop and Python Programming Lab

Course Objectives:
1. To introduce client-side scripting with JavaScript.
2. To gain knowledge on server-side programming with Servlets, JSP.
3. To understand web programming with python using Django and flask.

List of Programs:
Week 1:
- Installations of XAMPP stack.
- Understanding of Full stack of Python Web Technologies and Installations (Pycharm, Flask, Django)

Week 2:
1) Write an HTML page that has one input, which can take multi-line text and a submit button. Once the user clicks the submit button, it should show the number of characters, words and lines in the text entered using an alert message. Words are separated with white space and lines are separated with new line character (Add CSS to customize the properties of tags).
2) Write an HTML that contains a selection box with a list of 5 countries. When the user selects a country, its capital should be printed next to the list. Add CSS to customize the properties of the font of the capital (color, bold and font size), change the background of page with javascript and HTML DOM.

Week 3:
3) Suppose XML Document contains one or more objective type questions. Each question has four alternatives, one of which is correct. Each question has also a number and an answer. A question can be identified uniquely by its number. Write sample XML file and write a DTD, XML schema for it. Clearly mention the assumptions you made.
4) Create an XML document that contains 10 users' information. Write a java program, which takes user id as input and returns user details by taking the user information by using XML document.
   Hint: Use DOM Parser and SAX Parser.

Week 4:
5) Create a user validation web application using **SERVLET**, where the user submits the login name and password to the server. The name and password are checked against the data already available in XML file instead of database and if the data matches, a successful login page is returned. Otherwise show a failure message to the user.
6) Create a user validation web application using **SERVLET**, where the user submits the login name and password to the server. The name and password are checked against the data already available in database and if the data matches, a successful login page is returned. Otherwise show a failure message to the user.
7) Create a web application Using **SERVLET** that lists all cookies stored in the browser on clicking "List Cookies" button. Add cookies if necessary.

Week 5:

8) Create a user registration web application using **JSP**, where the user provides the details like full name, email id, gender, age, contact address in web form to store in database.
9) Implement a web application using **JSP**, which takes a name as input and on submitting it, shows a hello <name> page where <name> is taken from the request. It shows start time at the right top comer of the page and provides a logout button. On clicking this button, it should show a logout page with Thank You <name> message with the duration of usage (hint: Use session to store name and time).
10) Create a simple calculator web application using **JSP**, that takes two numbers and an operator (+, /, • and. /.) from an HTML page and returns the result page with the operation performed on the operands, such that it stores each query in a database and checks the database first for the result. If the query is already available in the DB, it returns the value that was previously computed (from DB) or it computes the result and returns it after storing the new query and result in DB.

Implement the following with Django and flask

Week 6:

1) Create a web application to display “Hello world”
2) Create a User Registration web application to store the login name, password, mail id, contact number, and address in the database.

Week 7:

Implement web application with Django and flask to validate User, where the user submits the login name and password to the server. The name and password are checked against the data already available in Database and if the data matches, a successful login page is retuned, which also contain Logout option to exit the page. Otherwise, a failure message is shown to the user.

Week 8:

Implement web application with Django and flask that lists all cookies stored in the browser on clicking "List Cookies" button. Add cookies if necessary.

Week 9:

Implement web application with Django and flask to track the user which counts the number of times the user visited the site.

Week 10:

Implement web application with Django and flask to Create a model that saves user profile (profile picture, resume in pdf, basic information).

Week 11:

Create model to manage employee data using CRUD operations with Function Based View with Model Form in Django.

Week 12:

Create a web application to manage student data using CRUD using flask.

Text Books:

1. Uttam K. Roy, Web Technologies, OXFORD University press, 2010.
2. Arun Ravindran, Samuel Dauzon and Aidas Bendoraitis, Django: Web Development with Python, Packt Publishing, 2017.
3. Miguel Grinberg, Flask Web Development, 2nd Edition, O'Reilly Media, Inc., 2018.

Reference Books:

1. Robert S. Sebesta, Programming World Wide Web, 4th Edition, Pearson Education, 2014.
2. Hans Bergsten, Java Server pages, O'Reilly Media, 2009.
3. Mike McMillan, Web Programming with Python, Infinite Skills, 2012.

Online Resources:

1. https://www.w3schools.com
2. https://www.javatpoint.com
3. https://onlinecourses.nptel.ac.in
4. https://docs.djangoproject.com
5. https://flask.palletsprojects.com

Course Outcomes:

After completion of the course, students will be able to

1. Design different web applications using client and server-side technologies.
2. Parse and validate the data using XML.
3. Develop web applications using Servlets and JSP.
4. Connect databases to the server side applications.
5. Recognize various frameworks for web development using Python.
6. Gain knowledge for deployment of models in Server using Django and flask.

III Year B.Tech. CSE (AI&ML) II-Semester	**L**	**T**	**P**	**C**
Course Code:	**-**	**-**	**2**	**1**

COMPUTER VISION AND PATTERN RECOGNITION LAB

(Professional Elective-2)

(Common to CSE (AI&ML), CSE (DS))

Prerequisites: -Nil-

Course Objectives:

1. Familiarize with practical aspects of computing with images.
2. Apply basic operations for image enhancement.
3. Extract features using Histogram processing, Color, Edges.
4. Applying basic mathematical morphology concepts and segmentation.
5. Identifying various patterns using classification and clustering techniques.

Use any tool like OpenCV/ Scilab/ R Programming.

Week 1:

Familiarization of the tool used for computer vision.

Week 2:

Write programs for the following

a) Loading and displaying an image.
b) Reading and writing video files.
c) Image enhancement.

Week 3:

Write a program to smooth an image using

a) Gaussian filter b) Median filter

Week 4:

Apply morphological operations like dilation, erosion, opening and closing on the given image.

Week 5:

Write a program for edge detection using different edge detection masks.

Week 6:

Implement histogram calculation and equalization for the given image.

Week 7:

Convert the input image from RGB color space to CMY and HSV color space.

Week 8:

Apply Hough transformation on the given image to detect lines.

Week 9:

Classify the given images using Naïve Bayesian classifier.

Week 10:

Write a program to segment an image by K-Means clustering.

Week 11:
Write a program to reduce dimensionality using PCA for the given images.

Week 12:
Write a program to implement Hand written Recognition (Digit/Character).

Text Books:
1. Gary Bradski and Adrian Kaehler, Learning OpenCV, O'Reilly Media, Inc., 1st Edition, 2008.
2. Talita Perciano and Alejandro C Frery, Introduction to Image Processing Using R: Learning by Examples, Springer, 1st Edition, 2013.

Reference Books:
1. R C Gonzalez and R E woods, Digital Image Processing, Addison Pearson, 3rd Edition, 2013.
2. David A.Forsyth and Jean Ponce, Computer Vision-A Modern Approach, PHI, 1st Edition, 2003.

Online Resources:
1. https://atoms.scilab.org/toolboxes/IPCV/1.1
2. https://docs.opencv.org/2.4/doc/tutorials/tutorials.html
3. https://onlinecourses.nptel.ac.in
4. https://www.coursera.org
5. https://in.udacity.com

Course Outcomes:
After completion of the course, students will be able to
1. Understand fundamental image processing techniques required for computer vision.
2. Employ various image enhancement and edge detection techniques.
3. Extract features using Histogram Processing, Color.
4. Apply basic morphological operations and Hough transformation.
5. Evaluate various pattern classification techniques.
6. Analyze segmentation of images by clustering.

III Year B.Tech. CSE (AI&ML) II-Semester	**L**	**T**	**P**	**C**
Course Code:	**-**	**-**	**2**	**1**

INTERNET OF THINGS AND APPLICATIONS LAB

(Professional Elective-2)

(Common to CSE (AI&ML), CSE (DS))

Prerequisites: IT Workshop and Python Programming Lab

Course Objectives:

1. To impart necessary and practical knowledge of components of Internet of Things.
2. To introduce the Python Scripting Language which is used in many IoT devices.
3. To introduce the Raspberry Pi platform, that is widely used in IoT applications.
4. Develop the required skills to build real-life IoT based projects.

List of Experiments:

Install the following on the local machine.

- Raspberry Pi OS.
- Python.

Implement and test the following experiments on a Raspberry Pi.

Week 1:

Familiarization of the equipment used for IoT lab.

Week 2:

Start Raspberry Pi and try various Linux commands in command terminal window: ls, cd, touch, mv, rm, man, mkdir, rmdir, tar, gzip, cat, more, less, ps, sudo, cron, chown, chgrp, ping.

Week 3:

a. Program to Read your name and print Hello message with name.
b. Program to Read two numbers and print their sum, difference, product and division.

Week 4:

a. Program to display Word and character count of a given string.
b. Program to calculate Area of a given shape (rectangle, triangle and circle) reading shape and appropriate values from standard input.

Week 5:

a. Program to print a name ‘n’ times, where name and n are read from standard input, using for and while loops.
b. Program to Handle Divided by Zero Exception.

Week 6:

Program to print current time for 10 times with an interval of 10 seconds. Read a file line by line and print the word count of each line.

Week 7:

Light an LED through Python program.

Week 8:

Program to get input from two switches and switch on corresponding LEDs.

Week 9:

Program to Flash an LED at a given on time and off time cycle, where the two times are taken from a file.

Week 10:
Program to Flash an LED based on cron output (acts as an alarm).

Week 11:
Program to switch on a relay at a given time using cron, where the relay's contact terminals are connected to a load.

Week 12:
Build a cloud-ready temperature sensor with the Raspberry Pi and any IoT Platform. (Use any freely available cloud platform to perform this program)

Suggested Case Studies/Industrial Applications:
1. Develop an IoT based web-controlled Home Automation using Raspberry Pi.
2. Build an application that has three LEDs (Red, Green and white). The LEDs should follow the cycle (All Off, Red On, Green On, White On) for each clap (use sound sensor).
3. Control a 230V device (Bulb) with Raspberry Pi using a relay.
4. Control a 230V device using a threshold temperature, using temperature sensor.

Text Books:
1. Vijay Madisetti and Arshdeep Bahga, Ïnternet of Things- A Hands on Approach, University Press.
2. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, Introduction to Internet of Things: A practical Approach, ETI Labs.

Reference Books:
1. Pethuru Raj and Anupama C. Raman, The Internet of Things: Enabling Technologies, platforms, and Use Cases, CRC Press.
2. Jeeva Jose, Internet of Things, Khanna Publishing House, Delhi.
3. Adrian McEwen, Designing the Internet of Things, Wiley.
4. Raj Kamal, Internet of Things: Architecture and Design, McGraw Hill.
5. Cuno P fister, Getting Started with the Internet of Things, O Reilly Media.

Online Resources:
1. https://www.tutorialspoint.com.
2. https://www.edureka.co.

Course Outcomes:
After completion of the course, students will be able to
1. Understand Internet of Things and its hardware and software components.
2. Identify the sensors and interfaces for I/O devices.
3. Create programs using python programming language.
4. Interface IoT communication modules.
5. Remotely monitor data in Cloud.
6. Develop real life IoT based projects.

IV Year B.Tech. CSE (AI&ML) I-Semester	**L**	**T**	**P**	**C**
Course Code:	**3**	**-**	**-**	**3**

ENTREPRENEURSHIP AND PROJECT MANAGEMENT

(Common to CSE, CSE (AI&ML), CSE (DS), CST, ETE, EEE, ECE & IT)

Prerequisites: Managerial Economics and Financial Accounting,
Fundamentals of Management

Course Objectives:

1. To inculcate the entrepreneurial knowledge required to start and/or to run a business.
2. To hone the entrepreneurial skills and creating sensibility in entrepreneurial establishment.
3. To develop strategic skills in the project planning and implementation.

UNIT 1: (∼07 lectures)

Introduction to Entrepreneurship

Entrepreneurship - Introduction to Entrepreneurship and Entrepreneur - Characteristic and skills of an Entrepreneur - Factors affecting Entrepreneurship development -Types of Entrepreneurs - Entrepreneur Vs Intrapreneur, Entrepreneur Vs Entrepreneurship - Women Entrepreneurs - Growth and Problems - Incubation Centers.

UNIT 2: (∼10 lectures)

Entrepreneurial business selection and Entrepreneurial Finance

Entrepreneurial business selection: Criteria for selection of Business Structure - Types of Business Structures - Sole Proprietorship – Partnership - Limited Liability Partnership - One-person company - Joint stock company – Features - Merits & Demerits.

Entrepreneurial Finance: Factors affecting Fixed Capital and Working Capital requirements -Sources of raising Finance - Financial Institutions in India.

UNIT 3: (∼10 lectures)

Profit Planning Techniques

Capital Budgeting–Introduction - Need and Importance of Capital Budgeting -Traditional methods - Payback Period Method - ARR Method. Discounted Cash Flow Method – NPV - PI and IRR (simple problems).

Break-Even Analysis–Need, Scope and Significance - Assumptions - Advantages and Limitations - Practical Applications (with simple problems)

UNIT 4: (∼10 lectures)

Project Management

Network Analysis - Introduction to Network analysis – PERT& CPM Analysis. Identification of Critical Path - Probability of Completing the Project within a given time - Calculation of Float/Slack - Importance of PERT & CPM in Decision Making.

UNIT 5: (∼08 lectures)

Entrepreneurial Marketing

Marketing - Need for a New Product development process - Essentials of Marketing Management - Key success factors in Marketing - Marketing mix - Market Segmentation and Marketing Strategies based on PLC.

Text Books:

1. Dr. S. S. Khanka, Entrepreneurial Development, S.Chand and Company, 1st Edition.
2. L. S. Srinath, PERT & CPM – Principles & Applications, EWP, 3rd Edition.
3. Khan & Jain, Financial Management, TMH, 6th Edition.

Reference Books:

1. Philip Kotler, Marketing Management, Pearson, 15th Edition.
2. Robert. D.Hisirch, Mathew. J. Manimal, Michael. P. Peter and Dean A.Shepherd, Entrepreneurship, McGraw Hill, 9th Edition.
3. S. D. Sharma, Operations Research, Macmillan, 1st Edition.
4. Tulsian, Business organization & Management, Pearson, 1st Edition.

Online Resources:

Management Science II: http://nptel.ac.in/courses/122106032/

Course Outcomes:

After completion of the course, students will be able to

1. Possess sensibleness and skills required for establishment of business.
2. Construe the entrepreneurial ingenuity required for business functioning.
3. Give perception on the probable business structures for entrepreneurial decisions
4. Scrutinize the probable financial propositions in investment process.
5. Evaluate the entrepreneurial project feasibility of implementation and its profitability.
6. Delve the market for the product developed through entrepreneurial establishment.

IV Year B.Tech. CSE (AI&ML) I-Semester	**L**	**T**	**P**	**C**
Course Code:	**3**	**-**	**-**	**3**

NEURAL NETWORKS AND DEEP LEARNING

Prerequisites: Probability and Statistics, Introduction to Machine Learning

Course Objectives:

1. To understand the basic building blocks of artificial neural networks
2. To acquire knowledge of supervised / unsupervised learning in neural networks
3. To understand the basics of deep learning and regularization for deep learning
4. Explore the methods to develop optimized deep learning networks considering hyper parameters
5. Model solutions for real life problems using Convolution neural networks.

UNIT 1: (~ 9 Lecture Hours)
Introduction: History of Artificial Neural Networks, Knowledge–Based Information Processing, Neural Information Processing, Hybrid Intelligence.
Basic Neural Computational Models: Introduction, Basic Concepts of Neural Networks, Inference and Learning, Classification Models, Association Models, Optimization Models, Self-Organization Models, General Issues, Hardware Implementation.

UNIT 2: (~ 9 Lecture Hours)
Learning-Supervised and Unsupervised: Introduction, Supervised and Unsupervised Learning, Statistical Learning, AI Learning, Neural Network learning.
Knowledge-based Neural Networks: Introduction, Rule-based Neural Networks, Network Training, Network Revision, Issues, Constraint based Neural Networks.

UNIT 3: (~ 11 Lecture Hours)
Introduction to Deep Learning: Historical Trends in Deep Learning,
Deep Feed forward Networks: Example: XOR, Gradient-based learning, Hidden units, Architecture design, Back-Propagation and other differentiation algorithms.
Regularization for Deep Learning: Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization under constrained problems, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Sharing, Sparse Representations, Bagging and Ensemble Methods, Dropout.

UNIT 4: (~ 9 Lecture Hours)
Optimization for Training Deep Models: How learning differs from Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate second order methods, Optimization strategies and Meta-algorithms.

UNIT 5: (~ 9 Lecture Hours)
Convolutional Networks: The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features, The Neuroscientific Basis for Convolution Networks, Convolution neural networks and History of Deep learning.
Types of CNN: LeNet, AlexNet, ResNet, VGG

Case Study: Natural Language Processing, Recommender System.

Text Books:

1. LiMin Fu, Neural Networks in Computer Intelligence, Tata McGraw-Hill Edition, 2003.
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning -MIT Press book, 2016.

Reference Books:

1. B. Vegnanarayana, Artificial Neural Networks, Prentice Hall of India, 2005.
2. Simon Haykin, Neural Networks a Comprehensive Foundations, PHI Edition, 2005.
3. Chao Pan, Deep Learning Fundamentals: An Introduction for Beginners, AI Sciences Publisher.

Online Resources:

1. https://www.coursera.org/learn/neural-networks-deep-learning
2. https://www.deeplearning.ai/program/deep-learning-specialization/

Course Outcomes:

After completion of the course, students will be able to

1. Understand the different types of neural networks for solving problems.
2. Apply neural network techniques for supervised and unsupervised learning problems.
3. Understand and apply regularization for deep learning neural networks.
4. Use optimization techniques for training deep models.
5. Gain knowledge on the basics and different architectures of Convolution neural networks
6. Use neural networks and deep learning techniques for solving real world problems.

IV Year B.Tech. CSE (AI&ML) I-Semester	**L**	**T**	**P**	**C**
Course Code:	**3**	**-**	**-**	**3**

FUZZY LOGIC AND APPLICATIONS

(Professional Elective - 3)

Prerequisites: Probability and Statistics, Discrete Mathematics

Course Objectives:

1. Provide an understanding of the basic mathematical elements of the theory in fuzzy sets, operations, their properties and Classical sets.
2. Understand the notions of Rule Based Systems.
3. Introduce the concept of decision problems.
4. The applications of Fuzzy control systems.

UNIT 1: (~ 6 Lecture Hours)

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets

Introduction to Fuzzy Logic, Classical Sets (Crisp Sets): Operations on Classical Sets, Fuzzy Sets: Fuzzy Set Operations, Union, Intersection, Complement, More operations on Fuzzy Sets, Properties of Fuzzy Sets.

Classical Relations and Fuzzy Relations

Introduction, Fuzzy Relations: Cardinality of Fuzzy Relations, Operations on Fuzzy Relations, Properties of Fuzzy Relations, Fuzzy Composition, Tolerance and Equivalence Relation: Classical Equivalence Relation, Classical Tolerance Relation, Fuzzy Equivalence Relation, Fuzzy Tolerance Relation.

UNIT 2: (~ 11 Lecture Hours)

Membership Functions: Introduction, Features of the Membership Functions, Fuzzification, Methods of Membership Value Assignments.

Defuzzification: Introduction, Lambda-Cuts for Fuzzy Sets (Alpha-Cuts), Lambda-Cuts for Fuzzy Relations, Defuzzification Methods.

UNIT 3: (~ 10 Lecture Hours)

Fuzzy Rule Base and Approximate Reasoning: Introduction, Truth Values and Tables in Fuzzy Logic, Fuzzy Propositions, Formation of Rules, Decomposition of Rules(Compound Rules), Aggregation of Fuzzy Rules, Fuzzy Reasoning(Approximate Reasoning): Categorical Reasoning, Qualitative Reasoning, Syllogistic Reasoning, Dispositional Reasoning, Fuzzy Inference Systems(FIS), Construction and Working Principle of FIS, Methods of FIS: Mamdani FIS, Takagi-Sugeno Fuzzy Model (TS Method), Comparison between Mamdani and Sugeno Method, Overview of Fuzzy Expert System.

UNIT 4: (~ 11 Lecture Hours)

Decision Making with Fuzzy Information: Fuzzy Synthetic Evaluation, Fuzzy Ordering, Nontransitive Ranking, Preference and Consensus, Multiobjective Decision Making, Fuzzy Bayesian Decision Making.

Fuzzy Classification: Classification by Equivalence Relations, Cluster Analysis, Cluster Validity, c-Means Clustering, Hard c-Means (HCM), Fuzzy c-Means (FCM), Classification Metric, Hardening the Fuzzy c-Partition, Similarity Relations from Clustering.

UNIT 5: (~ 10 Lecture Hours)

Fuzzy Pattern Recognition: Feature Analysis, Partitions of the feature Space, Single-Sample Identification.

Fuzzy Applications: Fuzzy Control Systems: Assumptions in a Fuzzy Control System Design, Simple Fuzzy Logic Controllers, Examples of Fuzzy Control System Design, Fuzzy Engineering Process Control, Fuzzy Statistical Process Control, Industrial Applications.

Text Books:

1. S.N Sivanandam and S.N. Deepa, Principles of Soft Computing, Wiley, India, 2007.
2. Fuzzy Logic with Engineering Applications, Third Edition by Timothy J. Ross , John Wiley & Sons, Ltd.

Reference Books:

1. Chennakesava R. Alavala, Fuzzy logic and neural networks: Basic concepts and applications, New Age International, 2007.
2. Rajshekaran and Pai, Neural Networks Fuzzy Logic & Genetic Algorithms, Prentice Hall, 2005.

Online Resources:

1. https://onlinecourses.nptel.ac.in
2. https://www.coursera.org

Course Outcomes:

After completion of the course, students will be able to

1. Understand the basic concept of fuzzy logic fundamentals.
2. Learn basics of Fuzzy Relations
3. Learn Fuzzy membership functions and Defuzzification techniques.
4. Apply classification techniques and Fuzzy decision making methods.
5. Understand the use of Fuzzy Pattern Recognition methods.
6. Basic understanding of fuzzy logic-applications.

IV Year B.Tech. CSE (AI&ML) I-Semester	**L**	**T**	**P**	**C**
Course Code:	**3**	**-**	**-**	**3**

DATA SCIENCE USING R

(Professional Elective - 3)

Prerequisites: Database Management Systems

Course Objectives:

1. To provide the knowledge and expertise to become a proficient data scientist.
2. Demonstrate an understanding of statistics and machine learning concepts that are vital for data science.
3. To understand R programming statistically to analyse a dataset.
4. Critically evaluate data visualization based on regression and time series in R.
5. To learn association rule mining and text mining algorithms for analysing the dataset.

UNIT 1: (~9 Lecture Hours)
Introduction to Data Science: Basics of data Science, Role in a Data Science Project, stages of a data science project-defining the goal, data Collection and management.
Introduction To R: Introduction, Downloading and Installing R, IDE and Text Editors, Handling, Packages in R, Working with Directory, Data Types, Commands for Data Exploration.
Loading and Handling Data in R: Introduction, Working with data from files, working with relational databases.

UNIT 2: (~9 Lecture Hours)
Exploring Data In R: Introduction, Data Frames, R Functions for Understanding Data in Data Frames, Load Data Frames, Exploring Data , Data Summary, Finding the Missing Values, Invalid Values and Outliers, Descriptive Statistics, Spotting Problems In Data with Visualization.
Managing Data in R: Cleaning data, sampling for Modeling and Validation.

UNIT 3: (~9 Lecture Hours)
Modeling Methods: Choosing and Evaluating models: Mapping problems to machine learning tasks, Evaluating Models, Validating Models.
Memorization Methods: KDD and KDD Cup 2009, Building Single variable models, Building models using many variables.

UNIT 4: (~9 Lecture Hours)
Linear Regression Using R: Introduction, Understanding Linear Regression, Building a Linear Regression Model, Making predictions.
Logistic Regression: Introduction, What Is Regression?, Introduction to Generalized Linear Model, Logistic Regression, Introduction, Understanding Logistic Regression, Building a Logistic Regression Model , Making predictions.
Unsupervised Methods: Cluster analysis – Distances, Preparing the data, Hierarchical clustering, The k-means algorithm.

UNIT 5: (~9 Lecture Hours)
Time Series in R: Introduction, What Is Time Series Data, Similarity Search in Time series Data, Regression and trend Analysis in Time series data, Reading Time Series Data, Ploting Time series Decomposing Time Series Data-Decomposing Seasonal Data, decomposing Non Seasonal data, Seasonal adjusting, Forecasts using Exponential smoothing, ARIMA models.

Text Books:

1. Nina Zumel and John Mount, Practical Data Science with R, 2nd Edition, Manning publications.
2. Seema Acharya, Data Analytics using R, 1st Edition, McGraw Hill Education.

Reference Books:

1. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman, Mining of Massive Datasets, V2.1, Cambridge University Press.
2. Foster Provost and Tom Fawcett, Data Science for Business, What You Need to Know about Data Mining and Data-Analytic Thinking, O'Reilly.
3. Cathy O'Neil and Rachel Schutt, Doing Data Science, Straight Talk from the Frontline, O'Reilly.
4. Samir Madhavan, Mastering Python for Data Science, Packt Publishing, 2015.

Online Resources:

1. http://datasciencemasters.org/.
2. http://learnds.com/
3. https://www.datascienceWeekly.org/

Course Outcomes:

After completion of the course, students will be able to

1. Understand and apply basic concepts of R for data science.
2. Learn and apply the fundamental concepts of data science.
3. Design suitable linear regression models to extract useful information.
4. Develop and analyze regression models for the given data.
5. Handle time series data using ARIMA models.
6. Analyse various association rule mining and text mining algorithms for better understanding.

IV Year B.Tech. CSE (AI&ML) I-Semester	**L**	**T**	**P**	**C**
Course Code:	**3**	**-**	**-**	**3**

BIG DATA ANALYTICS

(Professional Elective - 3)

Prerequisites: Database Management Systems

Course Objectives:

1. To know the fundamental concepts of big data.
2. Realize the Hadoop architecture and implementation of MapReduce Application.
3. Understand Big Data technologies and NoSQL.
4. To explore tools and practices for working with big data technologies.

UNIT 1: (~ 8 Lecture Hours)

Introduction to Big Data: Defining Big Data, Big Data Types, Analytics, examples, Technologies, The evolution of Big Data Architecture.

Basics of Hadoop: Hadoop Architecture, Main Components of Hadoop Framework, Analysis Big data using Hadoop, Hadoop clustering.

UNIT 2: (~ 9 Lecture Hours)

MapReduce: A Weather DataSet, Analyzing the data with Unix Tool, Analyzing the data using Hadoop, Hadoop streaming, Hadoop Pipes.

The Hadoop Distributed File System: Design of HDFS, Concepts, Basic File system Operations, Interfaces, Data Flow.

Hadoop I/O: Data Integrity, Compression, Serialization, File-Based Data Structures.

UNIT 3: (~ 10 Lecture Hours)

Developing A MapReduce Application: UNIT Tests with MRUNIT, Running Locally on Test Data.

How MapReduce Works: Anatomy of MapReduce Job Run, Classic MapReduce, Yarn, Failures in Classic MapReduce and Yarn, Job Scheduling, Shuffle and Sort, Task Execution.

MapReduce Types and Formats: MapReduce types, Input Formats, Output Formats.

UNIT 4: (~ 9 Lecture Hours)

NoSQL Data Management: Introduction, Types of NoSQL, Query Model for Big Data, Benefits of NoSQL, MongoDB.

Hbase: Data Model and Implementations, Hbase Clients, Hbase Examples, Praxis.

Hive: Comparison with Traditional Databases, HiveQL, Tables, Querying Data, User Defined Functions.

Sqoop: Sqoop Connectors, Text and Binary File Formats, Imports, Working with Imported Data.

UNIT 5: (~ 9 Lecture Hours)

Pig: Grunt, Comparison with Databases, Pig Latin, User Defined Functions, Data Processing Operators.

Spark: Installing steps, Distributed Datasets, Shared Variables, Anatomy of spark Job Run.

Scala: Environment Setup, Basic syntax, Data Types, Functions, Pattern Matching.

Text Books:

1. Tom White, Hadoop: The Definitive Guide, 3rd Edition, O'Reilley, 2012.
2. V.K. Jain, Big Data & Hadoop, Khanna Publishing House, 2017.

Reference Books:

1. P.J Sadalage and M. Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Addison-Wesley Professional, 2012.
2. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, Big Data, Big Analytics, John Wiley & Sons, Inc.2013.
3. Eric Sammer, Hadoop Operations, O'Reilley, 2012.
4. Lars George, HBase: The Definitive Guide, O'Reilley, 2011.
5. Alan Gates, Programming Pig, O'Reilley, 2011.
6. Jason Rutherglen, Dean Wampler and Edward Capriolo, Programming Hive, O'Reilley, 2012.

Online Resources:

1. https://www.tutorialspoint.com/hadoop/index.htm
2. https://www.tutorialspoint.com/hive/index.htm
3. https://www.tutorialspoint.com/hbase/index.htm
4. https://www.tutorialspoint.com/apache_pig/index.htm
5. https://www.tutorialspoint.com/scala/index.htm

Course Outcomes:

After completion of the course, students will be able to

1. Understands the basics of big data and its real time examples.
2. Describe the design of HDFS and Hadoop I/O.
3. Demonstrate the Hadoop architecture and implementation of MapReduce Application.
4. Understand Hadoop related database tools such as NoSQL, HBase and Hive.
5. Design Pig Scripts for Big Data Applications.
6. Develop large scale applications using Apache Spark and Scala.

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Course Code:	**3**	**-**	**-**	**3**

CLOUD COMPUTING AND VIRTUALIZATION

(Professional Elective - 4)
(Common to CSE (AI&ML), CSE (DS))

Prerequisites: Computer Networks, Operating Systems

Course Objectives:

1. To introduce the evolving computer model called cloud computing.
2. To present the cloud computing architecture.
3. To describe the perception of managing the cloud.
4. To introduce the various levels of services that can be achieved by cloud.
5. To familiarize the various cloud service providers.
6. To define the aspects of virtualization.

UNIT 1: (~9 Lecture Hours)
Cloud Computing Fundamentals: Motivation for Cloud Computing, Defining Cloud Computing, Principles of Cloud Computing, Cloud Ecosystem, Requirements for Cloud Services, Cloud Application, Benefits and Drawbacks.

UNIT 2: (~9 Lecture Hours)
Cloud Computing Architecture and Management: Introduction, Cloud Architecture, Anatomy of the Cloud, Network Connectivity in Cloud Computing, Applications on the Cloud, Managing the Cloud, Migrating Application to Cloud.

UNIT 3: (~9 Lecture Hours)
Cloud Service Models: Introduction, Infrastructure as a Service, Platform as a Service, Software as a Service, Other Cloud Service Models.

UNIT 4: (~9 Lecture Hours)
Cloud Service Providers: Introduction, EMC, Google, Cloud Platform, Amazon Web Services, Microsoft Cloud Platform, SAP Labs, Manjrasoft Aneka Cloud Platform.

UNIT 5: (~9 Lecture Hours)
Virtualization: Introduction, Virtualization Opportunities, Approaches to Virtualization, Hypervisors, From Virtualization to Cloud Computing.

Text Books:

1. K. Chandrasekhran, Essentials of cloud Computing, CRC Press, Taylor & Francis Group, an Informa business, ISBN: 978-1-49877-037-8, 2014.
2. Rajkumar Buyya, Cloud Computing Principles and Paradigms, Published by John Wiley & Sons, Inc., 2011.

Reference Books:

1. Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, Cloud Computing: Principles and Paradigms, Wiley, 2011.
2. Kai Hwang, Geoffery C. Fox and Jack J. Dongarra, Distributed and Cloud Computing, Elsevier, 2012.

Online Resources:

1. https://www.tutorialspoint.com/cloud_computing/index.htm
2. https://onlinecourses.nptel.ac.in/noc21_cs14/preview
3. https://aws.amazon.com/

Course Outcomes:

After completion of the course, students will be able to

1. Articulate the main concepts, strengths, and limitations of cloud computing.
2. Illustrate the broad perceptive of cloud architecture.
3. Analyze the various cloud management standards.
4. Ability to understand various service delivery models of cloud computing.
5. Understanding the unique features of major cloud service providers.
6. Apply and design appropriate virtualization concept.

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Course Code:	**3**	**-**	**-**	**3**

SPEECH AND NATURAL LANGUAGE PROCESSING

(Professional Elective- 4)

(Common to CSE (AI&ML), CSE (DS))

Prerequisites: Nil

Course Objectives:

1. To introduce the fundamental concepts and techniques of speech and natural language processing.
2. To understand the role of syntax and semantics of the text processing.
3. To introduce the basic concepts of phonetics and speech synthesis.
4. To gain an in-depth understanding of the computational properties and commonly used algorithms for processing speech and linguistic information.

UNIT 1: (~ 9 Lecture Hours)

Introduction: Knowledge in Speech and Language Processing, Ambiguity, Models and Algorithms, Language, Thought and Understanding, The State of the Art.

Regular Expressions and Automata: Regular Expressions, Finite-State Automata, Regular Languages and FSAs.

Words and Transducers: Survey of English Morphology, Finite State Morphological Parsing, Construction of a Finite State Lexicon, Finite State Transducers, FSTs for Morphological Parsing, Transducers and Orthographic Rules, Word and Sentence Tokenization, Detection and Correction of Spelling Errors, Minimum Edit Distance.

UNIT 2: (~ 10 Lecture Hours)

Part-of-Speech Tagging: English Word Classes, Tagsets for English, Part-of-Speech Tagging, Rule-Based Part-of-Speech Tagging, HMM Part-of-Speech Tagging.

Formal Grammars of English: Context Free Grammars, Some Grammar Rules for English. Treebanks, Grammar Equivalence and normal Form, Finite State and Context Free Grammars, Dependency Grammars, Spoken Language Syntax.

Syntactic Parsing: Parsing as Search, Ambiguity, Search in the face of ambiguity, Dynamic Programming Parsing Methods.

UNIT 3: (~ 10 Lecture Hours)

Statistical Parsing: Probabilistic Context Free Grammar, Probabilistic CKY Parsing of PCFGs, Ways to Learn PCFG Rule Probabilities, Problems with PCFGs, Improving PCFGs by splitting Non-Terminals.

Semantics: Computational Semantics- Syntax-Driven Semantic Analysis, Semantic Augmentation to Syntactic Rules, Quantifier Scope Ambiguity and Under Specification. Lexical Semantics- Word Senses, Relation between Senses, WordNet: A Database of Lexical Relations.

UNIT 4: (~ 10 Lecture Hours)

Phonetics: Speech Sounds and Phonetic Transcription, Articulatory Phonetics, Phonological Categories and Pronunciation Variation, Acoustic Phonetics and Signals, Phonetic Resources, Advanced: Articulatory and Gestural Phonology.

Speech Synthesis: Text Normalization, Phonetic Analysis, Prosodic Analysis, Evaluation.

UNIT 5: (~ 9 Lecture Hours)

Automatic Speech Recognition: Speech Recognition Architecture, The Hidden Markov Model Applied to Speech, Feature Extraction: MFCC Vectors, Acoustic Likelihood Computation -Vector Quantization, Gaussian PDFs, Search and Decoding, Embedded Training, Evaluation: Word Error Rate.

Text Books:

1. Daniel Jurafsky & James H. Martin, Speech and Language Processing, An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, 2nd Edition, Pearson Education, 2009.

Reference Books:

1. Tanvier Siddiqui, U.S. Tiwary, Natural Language Processing and Information Retrieval, Oxford Higher Education, 2008.
2. Daniel M. Bikel & Imed Zitouni, Multilingual Natural Language Processing Applications: From Theory to Practice, Pearson Publication, 2012.
3. Christopher D. Manning, and Hinrich Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.

Online Resources:

1. https://www.coursera.org/specializations/natural-language-processing
2. https://www.udemy.com/course/speech-recognition-a-z-with-hands-on-learnkarts/

Course Outcomes:

After completion of the course, students will be able to

1. Gain knowledge on the fundamental concepts and techniques of natural language processing.
2. Understand various types of Part-of-Speech Tagging and formal grammars of English.
3. Analyze the traditional and statistical approaches for syntax parsing.
4. Apply the computational and lexical semantics for language processing.
5. Understand the concepts of phonetics and speech synthesis.
6. Analyze various techniques used for automatic speech recognition.

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Course Code:	**3**	**-**	**-**	**3**

INFORMATION RETRIEVAL SYSTEMS

(Professional Elective - 4)
(Common to CSE (AI&ML), CSE (DS))

Prerequisites: Data Structures using C, Database Management Systems

Course Objectives:

1. To learn the different strategies for information storage and retrieval.
2. To learn about the various retrieval utilities.
3. To understand indexing and querying in information retrieval systems.
4. To understand the notion of structured and semi structured data.
5. To learn about retrieval model.

UNIT 1: (~ 10 Lecture Hours)
Introduction, **Retrieval strategies:** Vector space model.
Probabilistic retrieval strategies: Simple term weights, Non binary independence model, Language Models.

UNIT 2: (~ 8 Lecture Hours)
Retrieval Utilities: Relevance feedback, Clustering, Regression analysis, Thesauri.

UNIT 3: (~ 9 Lecture Hours)
Retrieval Utilities: N-grams, Semantic networks, Parsing
Cross-Language Information Retrieval: Introduction, Crossing the language barrier.

UNIT 4: (~ 9 Lecture Hours)
Efficiency: Inverted Index, Query Processing, Signature Files, Duplicate Document Detection

UNIT 5: (~ 9 Lecture Hours)
Integrating Structured Data and Text: A Historical Progression, Information Retrieval as relational application, Semi-structured search using a relational schema
Distributed Information Retrieval: A Theoretical model of distributed retrieval, Web search

Text Books:

1. David A. Grossman and Ophir Frieder, Information Retrieval-Algorithms and Heuristics, 2nd Edition, Springer.

Reference Books:

1. Gerald J Kowalski and Mark T Maybury, Information Retrieval Systems, Springer 2000.
2. Soumen Chakrabarti, Mining the Web: Discovering Knowledge from Hypertext Data, Morgan-Kaufmann Publishers, 2002.
3. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schutze, An Introduction to Information Retrieval, Cambridge University Press, Cambridge, England, 2009.

Online Resources:

1. http://www.unistmo.edu.mx/~daniel.garcia/MaterialDescargablePrivado/Librorecuperacioninformacion.pdf
2. http://www.swayam.gov.in
3. http://coursera.org

Course Outcomes:

After completion of the course, students will be able to

1. Have knowledge to store and retrieve textual documents using appropriate strategies.
2. Understand various retrieval utilities for improving search.
3. Understand the translation schemes of cross-language information retrieval.
4. Apply indexing and compression of documents to improve space and time efficiency.
5. Apply SQL queries for unstructured data.
6. Analyze and choose appropriate retrieval model.

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Course Code:	**-**	**-**	**2**	**1**

NEURAL NETWORKS AND DEEP LEARNING LAB

Prerequisites: IT Workshop and Python Programming Lab

Course Objectives:
1. Understand single layer and multilayer neural network training algorithms.
2. Implement regularized and optimized deep neural networks.
3. Understand the design of convolution neural networks.
4. Solve real world problems by considering various neural network architectures.

Programs:

Week 1:
Write a program to implement Perceptron.

Week 2:
Write a program to implement AND, OR gates using Perceptron.

Week 3:
Write a program to implement classification of linearly separable data with a single layer network.

Week 4:
Write a program to solve XOR problem using back propagation algorithm in multilayer neural networks.

Week 5:
Write a program to implement Backpropagation in deep neural networks.

Week 6:
Write a program to implement L1 and L2 Regularizations for deep learning models.

Week 7:
Implement the following optimization algorithms on deep neural networks
i) Stochastic Gradient Descent ii) AdaGrad iii)Adam

Week 8:
Write a program to implement Convolution neural network on any image dataset.

Week 9:
Write a program to find the similarity between two documents using neural networks.

Week 10:
Write a program to build speech to text model using deep neural networks.

Week 11:
Case study on implementation of recommender system.

Text Books:
1. François chollet, Deep Learning with Python, Manning publications Co., 2018.
2. Leonardo De Marchi and Laura Mitchell, Hands-On Neural Networks, packt publishing, 2019.

Reference Books:

1. Md. Rezaul Karim, Mohit Sewak and Pradeep Pujari, Practical Convolution Neural Networks, Packt publishing, 2018.
2. Dr Ardian Rosebock, Deep Learning for Computer vision, 3rd Edition, Pyimage Search.

Online Resources:

1. https://www.coursera.org/learn/neural-networks-deep-learning
2. https://www.deeplearning.ai/program/deep-learning-specialization/

Course Outcomes:

After completion of the course, students will be able to

1. Understand the characteristics and types of artificial neural networks.
2. Apply learning algorithms on perceptron
3. Apply back propagation learning on multilayer and deep neural network.
4. Build regularized and optimized deep neural networks.
5. Design Convolutional Neural Network on the given image dataset.
6. Solve real world problems by using neural network and deep learning techniques.

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NETWORK SECURITY

(Common to CSE (AI&ML), CSE (DS))

Prerequisites: Computer Networks

Course Objectives:

1. Understand the fundamentals of data Security.
2. Secure a message over insecure channel by various means.
3. Acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.
4. Understand the Security Standards of Web and Wireless Network.
5. Knowledge on Key management, IP Security and Email Security.

UNIT 1: (~9 Lecture Hours)
Introduction: Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A Model for Network Security.
Symmetric Encryption and Message Confidentiality: Symmetric Encryption Principles, Symmetric Block Encryption Algorithm, Random and Pseudorandom Numbers, Stream Ciphers and RC4, Cipher Block Modes of Operation.

UNIT 2: (~10 Lecture Hours)
Public-Key Cryptography and Message Authentication: Approaches to Message Authentication, Secure Hash Functions, Message Authentication Codes, Public-Key Cryptography Principles, Public-Key Cryptography Algorithms, Digital Signatures.
Key Distribution and User Authentication: Symmetric Key Distribution Using Symmetric Encryption, Kerberos, Key Distribution Using Asymmetric Encryption, X.509 Certificates, Public-Key Infrastructure.

UNIT 3: (~ 9 Lecture Hours)
Transport-Level Security: Web Security Considerations, Secure Socket Layer and Transport Layer Security, Transport Layer Security, HTTPS, Secure Shell (SSH).
Electronic Mail Security: Pretty Good Privacy, S/MIME, Domain Keys Identified Mail.

UNIT 4: (~8 Lecture Hours)
IP Security: IP Security Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange.
Malicious Software: Types of Malicious Software, Viruses, Virus Countermeasures, Worms, Distributed Denial of Service Attacks.

UNIT 5: (~8 Lecture Hours)
Firewalls: The Need for Firewalls, Firewall Characteristics, Types of Firewalls, Firewall Basing, Firewall Location and Configurations.

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. William Stallings, Network Security Essentials, 6th Edition, Pearson Education.
2. Atul Kahate, Cryptography and Network Security, 3rd Edition, McGraw Hill.

Reference Books:

1. William Stallings, Cryptography and Network Security - Principles and Practice, 6th Edition, Pearson Education.
2. Forouzan Mukhopadhyay, Cryptography and Network Security, 3rd Edition, Mc Graw Hill.

Online Resources:

1. https://www.udemy.com/course/data-security-and-privacy-training
2. https://nptel.ac.in/courses/106/105/106105162/
3. https://www.coursera.org/browse/computer-science/computersecurity-and networks?languages=en

Course Outcomes:

After completion of the course, students will be able to

1. Identify the various security threats and indicate countermeasures.
2. Illustrate various cryptographic algorithms.
3. Understand various message authentication algorithms and applications.
4. Identify security solutions for E-Mail and IP applications.
5. Demonstrate security solutions for web and internet.
6. Ability to identify information system requirements for both of them such as client and server.

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Course Code:	**3**	**-**	**-**	**3**

GAME THEORY

(Professional Elective - 5)

Prerequisites: Linear Algebra and Multivariable Calculus, Probability and Statistics

Course Objectives:

1. To understand the notions of game theory.
2. To introduce the problems and solutions of non-cooperative games.
3. To gain an in-depth understanding of imperfect information.
4. To introduce coalitional games.

UNIT 1: (~ 8 Lecture Hours)
Introduction: Game Theory, Games and Solutions, Game Theory and the Theory of Competitive Equilibrium, Rational behaviour, The Steady State and Deductive Interpretations.
Nash Equilibrium: Strategic Games, Nash Equilibrium, Examples, Existence of a Nash Equilibrium, Strictly Competitive Games.

UNIT 2: (~ 10 Lecture Hours)
Extensive Games with Perfect Information: Extensive Games with Perfect Information, Subgame Perfect Equilibrium, Two Extensions of the Definition of a Game, The Interpretation of a Strategy, Two Notable Finite Horizon Games, Iterated Elimination of Weakly Dominated Strategies.

UNIT 3: (~ 10 Lecture Hours)
Repeated Games: The Basic Idea, Infinitely Repeated Games vs. Finitely Repeated Games, Infinitely Repeated Games: Definitions, Strategies as Machines, Trigger Strategies: Nash Folk Theorems, Punishing for a Limited Length of Time: A Perfect Folk Theorem for the Limit of Means Criterion, Punishing the Punisher: A Perfect Folk Theorem for the Overtaking Criterion, Rewarding Players Who Punish: A Perfect Folk Theorem for the Discounting Criterion, The Structure of Subgame Perfect Equilibria Under the Discounting Criterion, Finitely Repeated Game.

UNIT 4: (~ 10 Lecture Hours)
Extensive Games with Imperfect Information: Extensive Games with Imperfect Information, Principles for the Equivalence of Extensive Games, Framing Effects and the Equivalence of Extensive Games, Mixed and Behavioral Strategies, Nash Equilibrium.

UNIT 5: (~ 10 Lecture Hours)
Coalitional Games: Coalitional Games with Transferable Payoff, The Core, Nonemptiness of the Core, Markets with Transferable Payoff, Coalitional Games without Transferable Payoff, Exchange Economies.

Text Books:

1. M. J. Osborne and A. Rubinstein, A course in Game Theory, MIT Press.

Reference Books:

1. Roger Myerson, Game Theory, Harvard University Press.
2. D. Fudenberg and J. Tirole, Game Theory, MIT Press.
3. J. von Neumann and O. Morgenstern, Theory of Games and Economic Behavior, New York, John Wiley and Sons.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc19_ge32
2. https://www.coursera.org/learn/game-theory-1

Course Outcomes:

After completion of the course, students will be able to

1. Understand the concepts of players, strategies, payoffs, rationality and equilibrium.
2. Formalize and solve games with a sequential structure.
3. Design logic of long term interaction.
4. Design games with partial information.
5. Solve non-cooperative games.
6. Structure coalitional games.

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Course Code:	**3**	**-**	**-**	**3**

HUMAN COMPUTER INTERACTION

(Professional Elective - 5)
(Common to CSE, CSE (AI&ML), CSE (DS))

Prerequisites: Nil

Course Objectives:

1. To learn the principles and fundamentals of Human computer interaction.
2. To understand contemporary theories developed for accounting HCI issues which include user behavior, cognitive, affective, interpersonal and social aspects in interaction design.
3. To acquire the skill to isolate the features of an existing interface design with flaws and improve them.

UNIT 1: (~8 Lecture Hours)
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 2: (~8 Lecture Hours)
Design process – Understanding How people interact with computers, Important Human characteristics in design, Human considerations in design, Human interaction speeds and understanding Business functions.

UNIT 3: (~12 Lecture Hours)
Screen Designing : Interface Design Goals – Screen Meaning and Purpose, Organizing Screen Elements, Ordering of Screen Data and Content – Screen Navigation and Flow – Visually Pleasing Composition – Amount of Information – Focus and Emphasis – Statistical Graphics, Types of Statistical Graphics.
Technological consideration in interface design: Graphical Systems, Web Systems, Examples of Screens.

UNIT 4: (~8 Lecture Hours)
Windows – Menus and Navigation Schemes, Select the Proper Kinds of Windows, Select the Proper Device Based Controls and Choose the Proper Screen Based Controls.
Components – Text and Messages, Icons and Multimedia, Colors - Uses, Problems, Choosing Colors.

UNIT 5: (~9 Lecture Hours)
Software tools – Specification methods, interface – Building Tools.
Interaction Devices – Keyboard and Function Keys – Pointing Devices – Speech Recognition Digitization and Generation – Image and Video Displays – Drivers.

Text Books:

1. Wilbert O Galitz, The Essential Guide to User Interface Design, Wiley Dreama Tech.
2. Ben Shneidermann, Designing the User Interface, 3rd Edition, Pearson Education Asia.

Reference Books:

1. Alan Dix, Janet Fincay, Gre Goryd, Abowd and Russell Bealg, Human - Computer Interaction. Pearson Education.
2. Prece, Rogers and Sharps, Interaction Design, Wiley Dreamtech.
3. Soren Lauesen, User Interface Design, Pearson Education.

Online Resources:

1. https://xsrv.mm.cs.sunysb.edu/hci/323studyguide.html#Ch1
2. https://onlinecourses.nptel.ac.in/noc18_cs23/preview [by Prof. PonnurangamKumaraguru]
3. http://nptel.ac.in/courses/106103115/ [by Dr. Samit Bhattacharya, Email: samit@iitg.ernet.inDept. of Computer Science &Engg.]
4. https://medium.com/ux-for-india/list-of-courses-for-ux-hci-or-id-aspirants-7f65770b33de

Course Outcomes:

After completion of the course, students will be able to

1. Recognize the importance of good screen design and gain knowledge of various graphical user interface concepts.
2. Demonstrate understanding of human sensory and cognitive system and the limitations of human performance in HCI.
3. Adapt and extend the classic screen design standards and guidelines.
4. Use various interface paradigms in the implementation of user interface design.
5. Choose appropriate screen components and employ specification methods for building interactive prototypes.
6. Determine the human computer interaction methods to meet the needs of practical software development process.

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Course Code:	**3**	**-**	**-**	**3**

DIGITAL FORENSICS

(Professional Elective - 5)
(Common to CSE (AI&ML), CSE (DS))

Prerequisites: Nil

Course Objectives:

1. To understand the fundamentals of Digital forensics and the role of digital evidences.
2. To understand the process of incident response and handling procedure of evidences.
3. To interpret various data collection, data duplication methods and tools
4. To understand different attacks and investigation techniques in Network, E-mail, Mobile and Cloud environments.
5. To describe the role and use of current forensic tools.

UNIT 1: (~ 9 Lecture Hours)
Digital forensics: Introduction, History, Rules of Computer/ Digital forensic, Digital Forensic as a Discipline, Definition of Digital Forensic, Digital Forensic Investigations, Goal of Digital Forensic Investigation.
Digital evidences: Introduction, What is Digital Evidence, Rules of Digital Evidence, Characteristics of Digital Evidence, Types of Evidence, Challenges in Evidence Handling, Volatile Evidence, Evidence Handling Procedures.
Incidence Response: Introduction, Goals of Incident Response, People involved in Incident Response, Incident Respond Methodology, Activities in initial response, Phases after detection of an incident.

UNIT 2: (~ 9 Lecture Hours)
Data Collection: Introduction, the facts in a criminal case, people involved in Data Collection Techniques, Live Data Collection, Live Data Collection Examples-Windows, Unix.
Forensic Duplication: Introduction, Rules of Forensic Duplication (Thumb Rule), Necessity of Forensic Duplication, Forensic Duplicates as admissible evidence, Important terms in Forensic Duplicate, Forensic Duplication Tool Requirements, Creating a Forensic duplicate of a Hard Drive, Creating a Qualified Forensic duplicate of a hard Drive.

UNIT 3: (~ 10 Lecture Hours)
Network Forensics: Introduction to IDS (Intrusion Detection System), Types of IDS, Advantages and Disadvantages, Understanding Network Intrusions and Attacks, Recognizing pre-intrusion/ Attack activities, Port Scans, Address Spoofing, Attacking with Trojans, Viruses and Worms, Understanding Password cracking, Understanding Technical Exploits, Collecting Network based evidence, Investigating routers, Network Protocols.
E-Mail Forensics: Importance of E-Mail as evidence, Working of E-Mail, Steps in E-mail communication, E-mail service protocols, E-Mail forensic analysis steps, E- Mail Forensic Tools.

UNIT 4: (~ 9 Lecture Hours)
Mobile Forensics: Mobile Hacking- SMS and Call Forging, Mobile Phone Forensics, Forensic Procedures, CIA Traid, Software and Hardware Mobile Phone Tricks, Android Forensics, Mobile Forensic Tools.
Computer Forensic Tools: Introduction, Evaluating Computer Forensic Tool needs, Types of Computer Forensic Tools, Tasks performed by Computer Forensic Tools, Tool Comparisons, Software Tools, Hardware Tools, Various Computer/ Digital Forensic Tools.

UNIT 5: (~ 8 Lecture Hours)
Cloud Forensics: Introduction, Three dimensions of Cloud Forensics, usage of Cloud Forensic, Challenges to Cloud Forensic, Impact of Cloud Computing on Digital Forensic, Cloud Forensic Tools.
File systems: Various Types of File Systems, Introduction to Storage Layers, Hard Disk Drive, Forensic Analysis of File Systems.

Text Books:
1. Dr. Neelakshi jain and Dr. Dhanajay R. Kalbande, Digital Forensic: The Fascinating World of Digital Evidences, Wiley Publications, 2017.
2. Kevin Mandia and Chris Prosise, Incident Response and computer forensics, Tata McGraw Hill, 2006.

Reference Books:
1. Nelson, Phillips Enfinger and Steuart, Computer Forensics and Investigations, Cengage Learning.
2. John R. Vacca, Computer Forensics, Computer Crime Investigation, Firewall Media, New Delhi.

Online Resources:
1. https://www.oreilly.com/library/view/digital-forensics-with/9781597495868/
2. https://onlinecourses.swayam2.ac.in/cec20_lb06/preview
3. https://www.mooc-list.com/course/digital-forensics-concepts-coursera
4. https://www.classcentral.com/course/edx-computer-forensics-7857

Course Outcomes:
After completion of the course, students will be able to
1. Understand the fundamental concepts of Digital Forensic, Digital Evidence and the Incident Response Process.
2. Apply various data acquisition techniques and tools on the evidences.
3. Learn the methods applicable for different forensic investigations.
4. Usage of various forensic tools to analyse different forensics data.
5. Gains knowledge on cloud forensic procedures and challenges.
6. Understand the concept of file system and their use in forensic analysis.

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Course Code:	**3**	**-**	**-**	**3**

SOFTWARE PROJECT MANAGEMENT

(Professional Elective – 6)

(Common to CSE (AI&ML), CSE (DS))

Prerequisites: Nil

Course Objectives:

1. Create a Software System with a predetermined functionality and quality in a given time frame and with given costs.
2. Focusing on principles, techniques, and methods applicable for various software projects.
3. To analyze different types of tools for Model Based Management of Software Projects.

UNIT 1: (~ 9 Lecture Hours)

Conventional Software Management: The waterfall model, conventional software Management performance.

Evolution of Software Economics: Software Economics, pragmatic software cost estimation.

Improving Software Economics: Reducing Software product size, improving software processes, improving team effectiveness, improving automation, Achieving required quality, peer inspections.

UNIT 2: (~ 10 Lecture Hours)

The old way and the new: The principles of conventional software engineering, principles of modern software management, transitioning to an iterative process.

Life cycle phases: Engineering and production stages, inception, Elaboration, construction, transition phases.

Artifacts of the process: The artifact sets, Management artifacts, Engineering artifacts, programmatic artifacts.

UNIT 3: (~ 9 Lecture Hours)

Model based software architectures: A Management perspective and technical perspective.

Work Flows of the process: Software process workflows, Iteration workflows.

Checkpoints of the Process: Major Mile Stones, Minor Milestones, Periodic status assessments.

UNIT 4: (~ 10 Lecture Hours)

Iterative Process Planning: Work breakdown structures, planning guidelines, cost and schedule estimating, Iteration planning process, Pragmatic planning.

Project Organizations and Responsibilities: Line-of-Business Organizations, Project Organizations, evolution of Organizations.

Process Automation: Automation Building Blocks, The Project Environment.

UNIT 5: (~ 10 Lecture Hours)

Project Control and Process instrumentation: The seven core Metrics, Management indicators, quality indicators, life cycle expectations pragmatic Software Metrics, Metrics automation.

Tailoring the Process: Process discriminants, Example.

Future Software Project Management: Modern Project Profiles Next generation Software economics, modern Process transitions.

Case Study: The Command Center Processing and Display System-Replacement (CCPDS-R)

Text Books:

1. Walker Royce, Software Project Management, Pearson Education, 1998.
2. Bob Hughes and Mike Cotterell, Software Project Management, 4th Edition, Tata Mc-Graw Hill, 2006.

Reference Books:

1. Andrew Stellman and Jennifer Greene, Applied Software Project Management, O'Reilly, 2006
2. Jennifer Greene and Andrew Stellman, Head First PMP, O'Reilly,2007
3. Richard H. Thayer and Edward Yourdon, Software Engineering Project Management, 2nd Edition, Wiley India, 2004.
4. Jim Highsmith, Agile Project Management, Pearson Education, 2004.
5. Scott Berkun, The art of Project management, O'Reilly, 2005.
6. Pankaj Jalote, Software Project Management in Practice, Pearson Education, 2002.

Online Resources:

1. https://www.projectmanager.com/resources
2. https://www.pcmag.com/roundup/260751/the-best-project-management-software.
3. http://www.onlinecourses.nptel.in
4. http://www.coursera.org/

Course Outcomes:

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

1. Differentiate Conventional Software Management with respect to Modern Practices.
2. Determine the various lifecycles of a Software Project.
3. Understand the specific roles with in a Software Organization as related to Project and Process Management.
4. Analyze the basic infrastructure competences like Process Modeling and Measurement.
5. Remember the basic steps of Project Planning and Project Management.
6. Assess the Quality Assurance, Process Management and their relationships along with the Case Study.

IV Year B.Tech. CSE (AI&ML) II-Semester	**L**	**T**	**P**	**C**
Course Code:	**3**	**-**	**-**	**3**

REAL TIME SYSTEMS

(Professional Elective - 6)
(Common to CSE (AI&ML), CSE (DS))

Prerequisite: Computer Organization and Architecture, Operating Systems

Course Objectives:

1. To provide broad understanding of the requirements of Real Time Operating Systems.
2. To make the student understand, applications of these Real Time features using case studies.
3. To formally specify and verify of timing constraints and properties.
4. To understand scheduling policies, process concurrency and synchronization.

UNIT 1: (~ 8 Lecture Hours)
Introduction, File I/O, Process control: Introduction to UNIX/LINUX, Overview of Commands, File I/O, (open, create, close, lseek, read, write), Process Control (fork, vfork, exit, wait, waitpid, exec).

UNIT 2: (~ 10 Lecture Hours)
Real Time Operating Systems: Brief History of OS, Defining RTOS, The Scheduler, Objects, Services, Characteristics of RTOS.
Tasks: Defining a Task, Asks States and Scheduling, Task Operations, Structure, Synchronization, Communication and Concurrency.
Semaphores: Defining Semaphores, Operations and Use

UNIT 3: (~ 9 Lecture Hours)
Message Queues: Defining Message Queue, States, Content, Storage, Operations and Use
Kernel Objects, RTOS Services and I/O Subsystem: Pipes, Event Registers, Signals, Other Building Blocks, Component Configuration, Basic I/O Concepts, I/O Subsystem

UNIT 4: (~ 10 Lecture Hours)
Exceptions, Interrupts and Timers: Exceptions, Interrupts, Applications, Processing of Exceptions and Spurious Interrupts, Real Time Clocks, Programmable Timers, Timer Interrupt Service Routines (ISR), Soft Timers, Operations.

UNIT 5: (~ 8 Lecture Hours)
Case Studies of RTOS: RT Linux, MicroC/OS-II, Vx Works, Embedded Linux.

Text Books:

1. Qing Li, Real Time Concepts for Embedded Systems, Elsevier, 2011.
2. W.Richard Stevens and Stephen A. Rago, Advanced Programming in the Unix Environment, 3rd Edition, Addison- Wesley, 2013.

Reference Books:

1. Rajkamal, Embedded Systems- Architecture, Programming and Design, TMH, 2007.
2. Dr. Craig Hollabaugh, Embedded Linux: Hardware, Software and Interfacing, Addison- Wesley, 2002.

Online Resources:

1. http://www.nptelvideos.in/2012/11/real-time-systems.html
2. https://books.google.co.in/books?id=pWlbvW0H3IAC&printsec=frontcover&dq=EMBEDDED%20SYSTEMS%20RAJ%20KAMAL&hl=en&sa=X&redir_esc=y#v=onepage&q=EMBEDDED%20SYSTEMS%20RAJ%20KAMAL&f=true

Course Outcomes:

After completion of the course, students will be able to

1. Understand real-time concepts such as pre-emptive multitasking, task priorities, priority inversions, mutual exclusion, context switching, and synchronization, interrupt latency and response time and semaphores.
2. Describe how a real-time operating system kernel is implemented.
3. Understand how tasks are managed.
4. Discuss how tasks can communicate using semaphores, mailboxes, and queues.
5. Implement a real-time system on an embedded processor.
6. Gain knowledge to work with any real time operating system.

IV Year B.Tech. CSE (AI&ML) II-Semester	**L**	**T**	**P**	**C**
Course Code:	**3**	**-**	**-**	**3**

AUGMENTED AND VIRTUAL REALITY

(Professional Elective - 6)

Prerequisites: Nil

Course Objectives:

1. To introduce the fundamental concepts of Computer Graphics and Augmented Reality.
2. To understand Augmented Reality hardware & software.
3. To gain knowledge on Augmented Reality framework.
4. To apply VR in real world scenario.
5. To explore VR applications and mixed reality concepts.

UNIT 1: (~ 9 Lecture Hours)

Fundamentals of Computer Graphics, Visualization, Image Processing, Graphical User Interface, Three-Dimensional Viewing Devices, Stereoscopic and Virtual-Reality Systems.
What is Augmented Reality, Introduction, Where did Augmented Reality come from, Relationship between Augmented Reality and other Technologies, How does Augmented Reality work, Concepts Related to Augmented Reality, Ingredients of an Augmented Reality Experience.

UNIT 2: (~ 8 Lecture Hours)

Augmented Reality Hardware-Introduction, Major Hardware Components for Augmented Reality Systems.
Augmented Reality Software- Introduction, Major Software Components for Augmented Reality Systems, Software used to Create Content for the Augmented Reality Application.

UNIT 3: (~ 9 Lecture Hours)

Content is Key! -Augmented Reality Content-Introduction, Creating visual content, Creating audio content, Creating content for other senses, Representation and perceptual issues.
Interaction in Augmented Reality-Introduction, What is interaction, AR Applications-Introduction, What makes a good Augmented reality application, Application areas.

UNIT 4: (~ 10 Lecture Hours)

Introduction to Virtual Reality, What is virtual reality, The beginnings of VR, VR Paradigms, Virtual Reality Systems, Representation, User Interaction.
Applying Virtual Reality: The medium, Form and genre, What makes an application a good candidate for VR, Promising Application Fields, Benefits of Virtual Reality, Recent Trends in Virtual Reality Application Development, A Framework for VR Application Development.

UNIT 5: (~ 9 Lecture Hours)

Augmented and Mixed Reality: Differences between AR & VR, Challenges with AR & VR, Mobile Augmented reality, Medical Applications, Education Applications, Entertainment Applications.

Text Books:

1. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.
2. Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications, Foundations of Effective Design, Morgan Kaufmann, 2009.

Reference Books:

1. Donald Hearn and M. Pauline Baker, Computer Graphics C version, Pearson Education.
2. Burdea, G. C. and P. Coffet, Virtual Reality Technology, 2nd Edition, Wiley-IEEE Press, 2003/2006.
3. Grigore C. Burdea, Philippe Coiffet, Virtual Reality Technology, Wiley 2016.
4. Dieter Schmalstieg and Tobias Höllerer, Augmented Reality: Principles & Practice, Pearson Education India, 2016.
5. Kent Norman (Ed), Wiley Handbook of Human Computer Interaction, Wiley 2017.
6. Andy Field, Discovering Statistics Using SPSS, SAGE Publications Ltd., 2009.

Online Resources:

1. https://www.udemy.com/topic/augmented-reality/
2. https://www.coursera.org/courses?query=augmented%20reality
3. https://www.edx.org/learn/augmented-reality
4. https://nptel.ac.in/courses/106/106/106106138/

Course Outcomes:

After completion of the course, students will be able to

1. Understand the basics of Computer Graphics and concepts of Augmented Reality.
2. Explore AR hardware and implement the AR software.
3. Design the multimodal user interfaces.
4. Analyze the framework in VR using various software development tools in VR.
5. Cognize the concepts of mixed reality.
6. Create solutions to real time applications.

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III Year B.Tech. I-Semester				
Course Code: OE	**3**	**-**	**-**	**3**

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING/
DEPARTMENT OF INFORMATION TECHNOLOGY

FUNDAMENTALS OF DATA STRUCTURES

(Open Elective-1)

Prerequisites: -Nil-

Course Objectives:

1. Understand the basic concepts such as Linear and Non Linear Data structures.
2. Understand the notations used to analyze the performance of algorithms.
3. Understand the behavior of data structures such as stacks, queues, trees, search trees, graphs and their representations.
4. Choose the appropriate data structure for a specified application.
5. Understand and analyze various searching and sorting algorithms.

UNIT 1: (~10 Lecture Hours)
Basic concepts- Algorithm Specification, Performance Analysis- Time Complexity and Space Complexity, Asymptotic Notation-Big O, Omega and Theta notations, Introduction to Linear and Non Linear data structures. Stacks, Queues, Circular queues, Dequeue working and representation using arrays, Applications of stacks: infix to post fix conversion, postfix expression evaluation.

UNIT 2: (~9 Lecture Hours)
Linked list: Singly Linked List, Doubly Linked List, Circular linked list working and representation. Implementation of stacks and queues using linked list.

UNIT 3: (~9 Lecture Hours)
Trees: Terminology, Sequential and Linked representation, Tree traversals, Binary trees, Binary search trees, operations - insertion and Searching, m-way search trees (Definition only), B-trees-(Definition only).

UNIT 4: (~9 Lecture Hours)
Searching: Linear and binary Search methods.
Sorting: Bubble sort, Selection sort, Insertion sort, Quick sort, Merge sort, Heap sort, Time complexities.

UNIT 5: (~8 Lecture Hours)
Graphs: Terminology, sequential and linked representation.
Graph traversals: Depth First Search & Breadth First Search, Spanning trees, Prims and Kruskals method.

Text Books:

1. Horowitz, Sahni, and Anderson-Freed, Fundamentals of Data Structures in C, 2nd Edition, Universities Press.
2. Mark Allen Weiss, Data Structures and Algorithms in C, 2nd Edition, Addison-Wesley.

Reference Books:

1. R.F. Gilberg and B.A. Forouzan, Data structures: A Pseudocode Approach with C, 2nd Edition, Cengage Learning.
2. E. Balaguru Swami, C Programming & Data structures, TMH, 2013.
3. A.M. Tanenbaum, Y. Langsam and M.J. Augensrein, Data Structures using C, 2004, Pearson Education Asia.

4. S. Lipscutz and Schaum's Outline Data Structures, TMH, July 2017.
5. R. Thareja, Data Structures using C, Oxford University Press, October 2015.

Online Resources:

1. www.cise.ufl.edu/~sahni/dsaac.
2. www.geeksforgeeks.org/data-structures
3. https://www.tutorialspoint.com
4. https://onlinecourses.nptel.ac.in/
5. https://www.coursera.org/

Course Outcomes:

After completion of the course, students will be able to

1. Analyse the time and space complexities of algorithms.
2. Differentiate between linear and non-linear data structures.
3. Use basic data structures such as linked list, stack and queue for data representation.
4. Understand advanced data structures like binary trees, search trees and graphs.
5. Choose appropriate data structures to represent data items in real world problems.
6. Analyse various kinds of searching and sorting techniques.

	L	T	P	C
III Year B.Tech. I-Semester				
Course Code: OE	**3**	**-**	**-**	**3**

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING/
DEPARTMENT OF INFORMATION TECHNOLOGY

JAVA PROGRAMMING

(Open Elective-1)

Prerequisites: -Nil-

Course Objectives:

1. Learn the concepts of object oriented programming.
2. Introduce the implementation of inheritance, packages and interfaces.
3. Understand the concepts of exception handling and multithreading.
4. Introduce the java collection framework and I/O classes.
5. Gain knowledge in designing Graphical User Interface using applets and swing controls.

UNIT 1: (~ 8 Lecture Hours)
OOP concepts: Data Abstraction, Encapsulation, Inheritance, Polymorphism, Classes and Objects, Procedural and Object oriented programming paradigms.
Java Basics: History of Java, Java buzzwords, Data types, Variables, Arrays, operators, expressions, control statements, Introducing classes, Methods, Constructors, Inner classes, Anonymous Inner classes, String handling.

UNIT 2: (~ 8 Lecture Hours)
Inheritance: Inheritance concepts, Member access, Creating Multilevel hierarchy, using super, using final with inheritance, forms of inheritance, benefits of inheritance, costs of inheritance, Polymorphism, method overriding, abstract classes, Object class.
Packages: Defining a Package, CLASSPATH, Access Protection, Importing packages.
Interfaces: Defining an Interface, implementing Interfaces, Nested interfaces, Variables in interfaces and Extending Interfaces.

UNIT 3: (~ 8 Lecture Hours)
Exception handling: Fundamentals of Exception Handling, Exception Types, Using try and Catch, multiple Catch Clauses, Nested Try statements, Throw, Throws and finally, built-in exceptions, creating own exception sub classes.
Multithreading: Differences between thread-based multitasking and process-based multitasking, Java thread model, creating threads, thread priorities, synchronizing threads, inter thread communication.

UNIT 4: (~ 8 Lecture Hours)
Stream based I/O (java.io): The Stream classes - Byte streams and Character streams, Reading console Input and Writing Console Output, File class, Reading and writing files, Random access file operations, Generics, Enumerations.
The Collections Framework (java.util): Collections overview, Collection Interfaces, The Collection classes- Array List, Linked List, Iterator, Stack, Vector, String Tokenizer, Scanner.

UNIT 5: (~ 10 Lecture Hours)
Event Handling: The Delegation Event Model - Events, Event sources, Event Listeners, Event classes, Handling mouse and keyboard events, Adapter classes.
GUI Programming with Swing: Introduction, limitations of AWT, MVC architecture, Swing components, Swing containers, Swing Controls - JLabel, JTextField, JButton, JToggleButton, JCheckBox, JRadioButton, JTabbedPane, JScrollPane, JList, JComboBox, Swing Menus, Dialogs. Layout Managers- FlowLayout, BorderLayout, GridLayout, CardLayout, GridBagLayout.
Applets: The Applet class, Difference between Applets and Applications, Life Cycle of an Applet, passing parameters to applets.

Text Books:
1. Herbert Schildt, Java- The Complete Reference, 9th Edition, McGraw Hill Education (India) Pvt. Ltd.
2. Herbert Schildt and Dale Skrien, Java Fundamentals - A comprehensive Introduction, McGraw Hill Education (India) Pvt. Ltd., 2013.

Reference Books:
1. Jaime Nino and Frederick. A. Hosch, An Introduction to Programming and Object Oriented Design using Java, John Wiley & sons, 2013.
2. Timothy Budd, Understanding Object-Oriented Programming with Java, updated Edition, Pearson Education.
3. Y. Daniel Liang, Introduction to Java Programming, Comprehensive Version, 7th Edition, Pearson Education.
4. P. Radha Krishna, Object Oriented Programming through Java, Universities Press 2008.

Online Resources:
1. https://docs.oracle.com/javase/tutorial/java/TOC.html
2. www.javatpoint.com/java-tutorial
3. https://onlinecourses.nptel.ac.in/
4. https://www.coursera.org/

Course Outcomes:
After completion of the course, students will be able to
1. Understand the object oriented programming concepts and solve real world problems.
2. Demonstrate the use of inheritance and packages.
3. Understand and implement the concepts of exception handling.
4. Develop multithreaded applications with synchronization.
5. Solve problems using java collection framework and I/O classes.
6. Design Graphical User Interface using applets and swing controls.

III Year B.Tech. I-Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING/
DEPARTMENT OF ELECTRONICS AND TELEMATICS ENGINEERING

BASIC ELECTRONICS

(Open Elective-1)

Prerequisite: -Nil-

Course Objectives:
1. To review the basic concepts of semiconductor physics.
2. To understand the concept of electronic devices, circuits and their applications.
3. To explore the construction, operation and characteristics of various electronic devices like diodes, transistors (BJTs and FETs).
4. To distinguish between various special purpose diodes.

UNIT 1: (~10 Lecture Hours)
P-N Junction Diode: Volt-Ampere characteristics, Ideal versus practical, Static and dynamic resistances, Equivalent circuits, Load line analysis, Applications of pn Diode. Break down Mechanisms-Avalanche breakdown, Zener breakdown and its applications.
Rectifiers: P-N junction as a rectifier - Half Wave Rectifier, Full Wave Rectifier: performance parameters.

UNIT 2: (~ 10 Lecture Hours)
Bipolar Junction Transistor (BJT): Construction, Principle of Operation, Symbol, Amplifying Action, Common Emitter, Common Base and Common Collector configurations.
Transistor Biasing and Stabilization: Operating point, DC & AC load lines, Biasing Voltage divider bias.

UNIT 3: (~ 10 Lecture Hours)
Field Effect Transistors: JFET Construction and Principle of operation, Symbol, Pinch-Off Voltage, Volt-Ampere Characteristic, MOSFET characteristics (Enhancement and depletion mode), Symbols of MOSFET, Comparison of BJT and
FET, Introduction to CMOS circuits.

UNIT 4: (~ 10 Lecture Hours)
Small Signal Low Frequency Model of BJT: BJT modeling, Hybrid model, Determination of h-parameters from transistor characteristics, Analysis of CE, CB and CC configurations using h-parameters, low frequency response of BJT Amplifiers, effect of coupling and bypass capacitors, Comparison of CE, CB and CC configurations.

UNIT 5: (~ 08 Lecture Hours)
Special purpose Diodes: Opto-Electronic Devices – LEDs, Photo Diode and Applications, Silicon Controlled Rectifier (SCR) – Operation, Construction, Characteristics, Ratings, Applications.

Text Books:
1. J.Millman, C.C.Halkias, and Satyabratha Jit, Electronic Devices and Circuits, 2nd Edition, Tata McGraw Hill, 2007.
2. R.L. Boylestad and Louis Nashelsky, Electronic Devices and Circuits, 9th Edition, Pearson/Prentice Hall, 2006.
3. T.F. Bogart Jr., J.S.Beasley and G.Rico, Electronic Devices and Circuits, 6th Edition, Pearson Education, 2004.

Reference Books:

1. S.G.Burns and P.R.Bond, Principles of Electronic Circuits, 2nd Edition, Galgotia Publications, 1998.
2. Millman and Grabel, Microelectronics, Tata McGraw Hill, 1988.
3. G. Streetman and S. K. Banerjee, Solid State Electronic Devices, 7th Edition Pearson, 2014.
4. C.T. Sah, Fundamentals of Solid State Electronics, World Scientific Publishing Co. Inc, 1991.

Online Resources:

1. http://www.radio-electronics.com
2. https://users.encs.concordia.ca/~rabinr
3. https://circuitdigest.com/electronic-circuits
4. -NPTEL
5. -edX

Course Outcomes:

After completion of the course, students will be able to

1. Illustrate the fundamental behaviour of various diodes, transistors.
2. Explain the construction, operation and characteristics of BJT, JFET and MOSFET.
3. Analyse the various amplifier circuits using small signal hybrid model.
4. Identify the necessity for biasing.
5. To know the operation of various special purpose devices like LED, Photo diode and SCR.
6. Apply the knowledge of Diodes in designing circuits like rectifiers.

III Year B.Tech. I-Semester	**L**	**T**	**P**	**C**
Course Code: OE	**3**	**-**	**-**	**3**

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ELECTRICAL MATERIALS

(Open Elective-1)

Prerequisite: -Nil-

Course Objectives:

1. To impart knowledge on the concepts of Dielectric electric materials in comparison with magnetic materials.
2. To introduce special purpose materials.
3. To make students familiar with the concepts of different materials for electrical applications.
4. To familiarize students with the internal concepts of electrical materials.

UNIT 1: (~ 10 Lecture Hours)
Dielectric and Semiconductor Materials: Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials.
Semiconductors: Intrinsic, Extrinsic types, Current carriers in semiconductor, Thermistors, Photoconductors, P-N junction Diode, Evolution of transistor.

UNIT 2: (~ 8 Lecture Hours)
Magnetic Materials: Classification of magnetic materials, properties of ferromagnetic materials, curie point, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials.
Special Purpose Materials - feebly magnetic materials, Ferrites, cast and cermet permanent magnets, Ageing of magnets. Factors effecting permeability and hysteresis.

UNIT 3: (~8 Lecture Hours)
Special Purpose Materials: Refractory Materials, Structural Materials, Radioactive Materials, Galvanization and Impregnation of materials, Processing of electronic materials, Insulating varnishes and coolants, Properties and applications of mineral oils, Testing of Transformer oil as per ISI.

UNIT 4: (~ 8 Lecture Hours)
Materials for Electrical Applications: Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetals fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation. Piezoelectric materials, Pyroelectric materials.

UNIT 5: (~ 8 Lecture Hours)
Materials for Specific Applications: Materials for solar cells, fuel cells and battery. Materials for coatings for enhanced solar thermal energy collection and solar selective coatings, Cold mirror coatings, heat mirror coatings, antireflection coatings. Sintered alloys for breaker and switch contacts.

Text Books:

1. R K Rajput, A course in Electrical Engineering Materials, Laxmi Publications, 2009.
2. C S Indulkar and S Thiruvengadam, An introduction to Electrical Engineering Materials, Revised Edition, S. Chand & Company, 2013.
3. T K Basak, A course in Electrical Engineering Materials, New Age Science Publications, 2009.

Reference Books:

1. A.J. Dekker, Electrical Engineering Materials, PHI Publication, 2006.
2. TTTI Madras, Electrical Engineering Materials, McGraw Hill Education, 2004.

Course Outcomes:

After completion of the course, students will be able to

1. Distinguish between magnetic and non-magnetic materials by acquiring the knowledge of their atomic structures.
2. Analyse Dielectric and semiconductor materials.
3. Analyse the magnetic materials using their properties.
4. Identify special purpose materials for different applications.
5. Analyse the working of different materials from the point of view of their applications in electrical industry.
6. Analyse the working of special purpose materials from the point of view of their possible applications electrical & other fields.

III Year B.Tech. I-Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF MECHANICAL ENGINEERING

OPERATIONS RESEARCH

(Open Elective-1)

Prerequisites: - Nil-

Course Objectives:

1. Study the linear programming and dynamic programming techniques used for business and engineering applications.
2. Know about the inventory, Game theory and replacement theory applications in real world.

UNIT 1: (~8 Lecture Hours)
Introduction to Operations Research: Basics definition, scope, objectives, phases, models and limitations of Operations Research. Linear Programming Problem-Formulation of LPP, Graphical solution of LPP. Simplex Method, Artificial variables, big-M methods, Special cases in LP-Degeneracy, unbounded, infeasibility & alternative optima.

UNIT 2: (~8 Lecture Hours)
Transportation Problem: Formulation, solution, unbalanced Transportation problem. Finding basic feasible Solutions-Northwest corner rule, Least cost method and Vogel's approximation method. Optimality test by MODI method & stepping stone method.

UNIT 3: (~8 Lecture Hours)
Assignment Model: Formulation, Hungarian method for optimal solution. Solving unbalanced Assignment problem.
Sequencing Models. Solution of sequencing Problem-Processing n jobs through 2 Machines-Processing n jobs through 3 Machines-Processing n jobs through m Machines. Processing 2 jobs through m-machines.

UNIT 4: (~8 Lecture Hours)
Dynamic Programming: Characteristics of Dynamic programming. Dynamic Programming approach for Coach/Shortest Path and cargo loading problems.
Inventory Models: Inventory costs. Models with deterministic demand- Model (a) Demand rate uniform and production rate infinite, Model (b) Demand rate uniform and production rate finite.

UNIT 5: (~8 Lecture Hours)
Games Theory: Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, and value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point-mixed strategy for 2*2 games.
Replacement Models: Replacement of items that deteriorate whose maintenance costs increase with time without change in the money value, Replacement of items that fail suddenly: Individual Replacement policy, Group Replacement policy.

Text Books:

1. P.SankaraIyer, Operations Research, Tata Mcgraw-Hill, 2008.
2. A.M. Natarajan, P. Balasubramani and A. Tamilarasi, Operations Research, Pearson Education, India, 2012.
3. Hamdy A Taha, Operations Research an Introduction, Pearson Education, 2010.

Reference Books:

1. S.D. Sharma, Operations Research Theory Methods and Applications, Kedarnath Ramnath Publishers, 2015.
2. P. K. Gupta and D. S. Hira, Operations Research, S. Chand & Co., 2014.
3. J K Sharma, Operations Research Problems and Solutions, 3rd Edition, Macmillan India Ltd, 2008.

Online Resources:

1. IOR Tutorials(Interactive Operations Research Tutorial)
2. http://www.nptel.ac.in

Course Outcomes:

After completion of the course, students will be able to

1. Apply linear programming models to several Engineering Applications.
2. Use several other techniques like Transportation, Assignment and Sequencing Models in the real world applications.
3. Study selected Dynamic Programming models for real world situations.
4. Apply simple mathematical models in Inventory into the real Engineering Applications.
5. Solve Game theory problems related to business applications.
6. Develop optimum replacement policy.

III Year B.Tech. I-Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF HUMANITIES & MATHEMATICS

INTRODUCTION TO DATA ANALYTICS

(Open Elective -1)

Prerequisites: - Nil-

Course Objectives:

1. To learn the importance of Probability and Statistics.
2. To know about the Regression.
3. To gain a basic knowledge on Supervised and Unsupervised Learning.
4. To study the concepts of Time Series Analysis.

UNIT 1: (~9 Lecture Hours)
Descriptive Statistics: Role of data analytics in science and engineering, different types of data and data Summarization methods; Measures of central tendency & measure of dispersion; Probability - Conditional probability, Baye's theorem. Random variables - Discrete, continuous probability distributions, expectations and variance.

UNIT 2: (~ 9 Lecture Hours)
Regression: Linear regression - Estimating co-efficient, assessing the accuracy of co-efficient estimates, assessing accuracy of the model. Multiple linear regression- Estimating co-efficient, relation between response and predictors, marketing plan comparison of linear regression with K-nearest neighbor.

UNIT 3: (~9 Lecture Hours)
Supervised Learning: Classification - Overview, logistic regression, multiple logistic regressions, linear discriminant analysis, Baye's theorem for classification, quadratic discriminant analysis, comparison of classification methods.

UNIT 4: (~9 Lecture Hours)
Unsupervised Learning: Associative rules - Generating candidate's rules, the Apriori algorithm, support and confidence, lift ratio, the process of rule selection and interpreting results.
Clustering- measuring distances between two records, measuring distances between two clusters, hierarchical (Agglomerative) clustering, non- hierarchical clustering, K-means algorithm.

UNIT 5: (~9 Lecture Hours)
Time Series Analysis: Introduction, significance of time series analysis, components of time series, secular trend, freehand of graphic method, semi-average method, method of moving averages, method of least squares, straight linear and non-linear trends, logarithmic methods, exponential trends, growth curves, seasonal variation, method of simple averages, ratio-to-trends, ratio-to-moving average method.

Text Books:

1. S. P. Gupta, Statistical Methods, 33rd Edition, Sultan - Chand & Sons.
2. Galit Shmueli, Peter C. Bruce, Inbal Yahav, Nitin R. Patel and Kenneth C. Lichtendahl Jr., Data Mining For Business Analytics Concepts, Techniques, and Applications in R, Wiley Publications.
3. Hastie and Trivor, et al., The Elements of Statistical Learning. Vol.2, No.1.Newyork, Springer, 2009.

Reference Books:

1. Montgomery, Douglus C., and George C.Runger. Applied Statistics and Probability for Engineers John Wiley & Sons. 2010.
2. Tang-Ning-Tan, Micheal-Steinbach, Vipin Kumar, Anuj Karpatne, Introduction to Data Mining, Pearson India Education Services Ltd, 2016.
3. Roxy Peck, San Luis Obispo and Iowa Jay L. Devore, Introduction to Statistics and Data Analysis, 5th Edition, Cengage Learning.

Online Resources:

1. onlinelibrary.wiley.com
2. nptel.ac.in/courses/Introduction to Data Analytics

Course Outcomes:

After completing the course, student will be able to

1. Understand the definitions and concepts associated with central tendency and measures of dispersion.
2. Find the probability of an event and know the properties of distribution.
3. Determine the regression co-efficient and test the accuracy of co-efficient.
4. Learn basic concepts in supervised learning.
5. Attain basic knowledge in unsupervised learning.
6. Understand past behavior of data and forecast the future behavior using time series analysis.

III Year B.Tech. I-Semester	**L**	**T**	**P**	**C**
Course Code: OE	**3**	**-**	**-**	**3**

DEPARTMENT OF HUMANITIES & MATHEMATICS

INTELLECTUAL PROPERTY RIGHTS

(Open Elective -1)

Prerequisites: -Nil-

Course Objectives:

1. To educate the importance of IPR in Engineering.
2. To enlighten the various types of IP's and their protection.
3. To maintain IPR's for Business sustainability.

UNIT 1: (~**09** Lecture Hours)

Introduction to Intellectual property

Intellectual property: Introduction – Features - Types of Intellectual property - International organizations - Agencies and treaties, Conventions – Importance of Intellectual property rights.

UNIT 2: (~**08** Lecture Hours)

Patents

Patents: Concept of Patent – Duration – Patent Process – Patent searching process – Procedure for filling Application of Patents - Ownership, Transfer, Assignment and Licensing of Patent – Remedies for Infringement of Patents.

UNIT 3: (~**10** Lecture Hours)

Copyrights and Trademarks

Copyrights – Fundamental of Copy right law - Originality of material- Rights of Reproduction - Rights to perform the work publicly - Copyright Ownership issues - Copyright registration - Notice of Copyright - Remedies for infringement in Copyrights.

Trademarks – Purpose and functions of Trademarks - Acquisition of Trademark rights - Protectable matter - Selecting and evaluating Trademark - Trademarks registration process – Remedies for infringement in Trade marks.

UNIT 4: (~**08** Lecture Hours)

Industrial Designs

Industrial Designs – Assignment of Design – Essential requirement of Registration – Registration Process of Industrial Designs – Benefits of registration – Assignment, Transmission and Licensing of Industrial Designs - Remedies for infringement of Designs.

UNIT 5: (~**10** Lecture Hours)

Trade Secrets

Trade Secrets – Trade secret law – determinants of Trade secret status - Liability for misappropriations of Trade Secrets – Protection for submission - Trade secret litigation – Unfair competition – Interface between Intellectual Property Rights and Competition – Safeguards against Unfair competitions.

Intellectual property audits – Types of IP Audit – Procedure of Preparing Audit – Auditing IP Assets.

Text Books:

1. Deborah. E. Bouchoux, Intellectual property right, Cengage learning.
2. Prabuddha ganguli, Intellectual property right – Unleashing the knowledge economy, Tate McGraw Hill Publishing company ltd.

Reference Books:

1. Kompal Bansal and Parikshit Bansal, Fundamentals of Intellectual property for Engineers, BS Publications, 2013.

Online Resources:

1. https://www.icsi.edu/media/webmodules/publications/9.4%20Intellectual%20Property%20Rights.pdf
2. Introduction on Intellectual Property to Engineers and Technologists https://nptel.ac.in/courses/109105112/

Course Outcomes:

After completion of the course, students will be able to

1. Understand the dynamics and legalistic framework of IPR's
2. Acquaint with securing patents and its protection.
3. Seize the dimensions of Copy right protection.
4. Realize the eminence of Trade Marks in growth of business.
5. Essentials of safeguarding Industrial designs.
6. Sustentation of Trade Secrets and aspects of IP audit.

III Year B.Tech. I-Semester	**L**	**T**	**P**	**C**
Course Code: OE	**3**	**-**	**-**	**3**

DEPARTMENT OF BASIC SCIENCES

DISASTER MANAGEMENT

(Open Elective -1)

Prerequisites: -Nil-

Course Objectives:

1. To understand the critical concepts in Disaster Management.
2. To gain the knowledge on the factors responsible for cause of various disasters.
3. To provide the information on different disasters, tools and methods for disaster management.
4. To provide an overview on the roles of Government and non-government agencies in disaster management.

UNIT 1: (~ 9 Lecture Hours)

Understanding Hazards and Disaster: Introduction – Environmental Hazard, Environmental Disaster and Environmental Stress. Concept of Disaster – Concept of Risk. Different approaches in Disaster Management. Levels of Disasters. Disaster Phenomena and Events (Global, National and Regional).

Hazards and Vulnerabilities: Classification of Hazards and Disasters - Natural and Man-made Hazards (Planetary, Extra Planetary, Endogenous and Exogenous Hazards). Characteristics and damage potential of natural hazards. Hazard assessment. Dimensions of vulnerability factors, vulnerability assessment and disaster risk. Vulnerabilities to flood and earthquake hazards.

UNIT 2: (~ 9 Lecture Hours)

Planetary and Extra Planetary Hazards: Endogenous Hazards and Exogenous Hazards.

Earthquake Hazards and disasters - Causes of Earthquakes, distribution of earthquakes, Hazardous effects of earthquakes, Earthquake Hazards in India, Human adjustment, perception and mitigation of earthquake.

Cyclones - Causes, Effects, distribution, human adjustment, perception and mitigation of Cyclones.

Cumulative Atmospheric Hazards and Disasters: Floods, Droughts, Cold waves and Heat waves.

Floods - Causes of floods, Effects of Floods, Flood hazards in India, Flood control measures, Human adjustment, perception and mitigation.

Droughts – Causes of Droughts, Impacts of droughts, Drought hazards in India, Drought control measures. Extra Planetary Hazards and Disasters - man induced Hazards and Disasters - Physical hazards and Disasters.

UNIT 3: (~ 8 Lecture Hours)

Disaster Management Mechanism: Concepts of risk management and crisis management. Disaster Management Cycle – Prevention, Mitigation, Preparedness, Response, Recovery and Rehabilitation. Planning for Relief.

UNIT 4: (~ 9 Lecture Hours)

Capacity Building & Coping with Disaster: Capacity Building: Concept, Structural and Nonstructural measures, Capacity assessment, Strengthening Capacity for Risk Reduction. Legislative support at State and National levels. Case Studies.

Coping Strategies: Alternative adjustment processes, changing concepts of disaster management. Industrial Safety Plan - Safety norms and survival kits. Role of Mass media in disaster management. Crowd Management.

UNIT 5: (~ 9 Lecture Hours)

Planning for Disaster Management: Strategies planning for disaster management, steps for formulating reduction in disaster risk. Disaster Management Act and Policy in India – Organizational structure for disaster management. Preparation of state and district level disaster management plans. Sendai Framework on Disaster Risk Reduction (DRR). Use of latest technologies – Remote Sensing (RS) and Geological Information System (GIS).

Text Books:

1. Manual on Disaster Management, National Disaster Management Agency, Govt of India.
2. Mrinalini Pandey, Disaster Management, 1st Edition, Wiley, 2014.
3. T. Bhattacharya, Disaster Science and Management, McGraw Hill Education (India) Private Limited, 2015.
4. Pradeep Sahni, Disaster Mitigation: Experiences and Reflections PHI Learning Private Limited, 2010.
5. Donald Hyndman and David Hyndman, Natural Hazards and Disasters, Cengage Learning, 2006.

Reference Books:

1. N. Pandharinath and CK Rajan, Earth and Atmospheric Disasters Management, BS Publications, 2009.
2. R. B. Singh, Environmental Geography, Heritage Publishers, New Delhi, 1990.
3. Savinder Singh, Environmental Geography Prayag Pustak Bhawann, 1997.
4. B. I. Kates and G. F. White, The Environment as Hazards, Oxford Press, New York, 1978.
5. R. B. Singh, Disaster Management, Rawat Publication, New Delhi, 2000.
6. H. K. Gupta, Disaster Management Universities Press, India, 2003.
7. R. B. Singh, Space Technology for Disaster Mitigation in India (INCED), University of Tokyo, 1994.
8. Satender, Disaster Management in Hills Concept Publishing Co., New Delhi, 2003.
9. R. K. Bhandani, An Overview on Natural and Manmade Disaster and their Reduction, CSIR, New Delhi.
10. M. C. Gupta, Manuals on Natural Disaster Management in India, National Centre for Disaster Management, IIPA, New Delhi, 2001.

Online Resources:

1. National Disaster Management Plan, Ministry of Home affairs, Government of India (http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf).
2. National Institute of Disaster Management (NIDM) (https://nidm.gov.in/)
3. WHO-Disaster Management Resources- https://www.who.int/surgery/publications/immesc_disaster_management/en/
4. https://swayam.gov.in/courses/4983-disaster-management
5. https://reliefweb.int/training/2455444/free-online-course-disaster-risk-reduction-and-management
6. https://www.unisdr.org/we/inform/events/47107
7. https://www.futurelearn.com/courses/disaster-management/2
8. https://www.ifrc.org/en/get-involved/learning-education-training/certified-professional-development-courses/online-certificate-programme-in-disaster-management/

Course Outcomes:

After completion of the course, students will be able to

1. Understand different kinds of disasters and their vulnerabilities.
2. Identify the causes, effects and mitigation measures of different disasters.
3. Apply the disaster management mechanism in natural and man induced calamities.
4. Analyse and solve the unforeseen situations with advanced technologies like Remote Sensing and Geological Information Systems.

III Year B.Tech. II-Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING/
DEPARTMENT OF INFORMATION TECHNOLOGY

OPERATING SYSTEMS

(Open Elective-2)

Prerequisites: -Nil-

Course Objectives:

1. To understand the role of OS in the overall computer system and study the operations performed by OS as a resource manager.
2. To understand the scheduling policies and different memory management techniques for different operating systems.
3. To understand process concurrency and synchronization.
4. To understand the concepts of I/O, storage and file management and introduce system call interface for file and process management.
5. To introduce the goals and principles of protection.

UNIT 1: (~ 10 Lecture Hours)
Introduction: Overview-Introduction-Operating system objectives, User view, System view, Operating system definition, Computer System Organization, Computer System Architecture, OS Structure, OS Operations, Process Management, Memory Management, Storage Management, Protection and Security, Computing Environments.
Operating System services, User and OS Interface, System Calls, Types of System Calls, System Programs, Operating System Design and Implementation, OS Structure.

UNIT 2: (~ 9 Lecture Hours)
Process: Process concepts-The Process, Process State, Process State transitions, Process Control Block, Context Switch.
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 3: (~ 10 Lecture Hours)
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 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, Recovery from Deadlock.

UNIT 4: (~ 10 Lecture Hours)
Memory Management: Basic Hardware, Address Binding, Logical and physical address space, Dynamic loading, linking and Shared libraries, Swapping, Contiguous Memory Allocation- Fixed and variable partition–Internal and External fragmentation and Compaction; Segmentation, Paging- Hardware support for paging, Protection, shared pages, Structure of Page Table. Case Studies: Linux, Windows.
Virtual Memory Management: Background, Demand Paging-locality of reference, Page fault; Copy-on-Write, Page replacement, Page Replacement Algorithms, Allocation of Frames, Thrashing.

UNIT 5: (~ 9 Lecture Hours)
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.
Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk formatting-Boot-block, Bad blocks.
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.

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.

Online Resources:
1. Abraham-Silberschatz-Operating-System-Concepts---9th2012.12.pdf
2. https://www.cs.uic.edu/~jbell/CourseNotes/OperatingSystems/

Course Outcomes:
After completion of the course, students will be able to
1. Acquire a High-level understanding of what is an operating system and the role it plays and the services it provides.
2. Understand process management concepts including scheduling, synchronization.
3. Describe System model for deadlock, Methods for handling deadlocks.
4. Understand of memory management including virtual memory.
5. Acquire Knowledge on issues related to file system interface and implementation.
6. Understand the issues related to disk management.

III Year B.Tech. II-Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING/
DEPARTMENT OF INFORMATION TECHNOLOGY

DATABASE MANAGEMENT SYSTEMS

(Open Elective-2)

Prerequisites: Data Structures, Operating Systems

Course Objectives:

1. To understand the basic concepts and the applications of database systems.
2. To master the basics of SQL and construct queries using SQL.
3. To understand the relational database design principles.
4. To become familiar with the basic issues of transaction processing and concurrency control.
5. To become familiar with database storage structure and recovery mechanisms.

UNIT 1: (~10 lecture Hours)
Introduction: Database System Applications, Purpose of Database Systems, View of Data, Database Languages – DDL, DML, Relational Databases, Data Storage and Querying, Transaction Management, Database Architecture, Database Users and Administrators.
Database Design and the E-R Model: The Entity-Relationship Model, Constraints, Removing Redundant Attributes in Entity Sets, Entity-Relationship Diagrams, Reduction to Relational schemas, Entity-Relationship Design Issues, Extended E-R Features.

UNIT 2: (~9 lectures Hours)
Introduction to the Relational Model: Structure of Relational Databases, Database Schema, Schema Diagrams. The Relational Algebra, Tuple Relational Calculus, Domain Relational Calculus.
Introduction to SQL: Overview of the SQL Query Language, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, Aggregate Functions, Nested Subqueries.

UNIT 3: (~10 lectures Hours)
Advanced SQL: Join Expressions, Views, Integrity Constraints, Triggers.
Normalization: Functional Dependencies, Lossless decomposition, 1NF, 2NF, 3NF, Dependency Preservation, BCNF, Multi–valued dependencies, 4NF, Join Dependencies, 5NF.

UNIT 4: (~10 lecture Hours)
Transaction Management: Transaction Concept, A Simple Transaction Model, Storage Structure, Transaction Atomicity and Durability, Transaction Isolation, Serializability, Transaction Isolation and Atomicity, Transaction Isolation Levels.
Concurrency Control: Lock-Based Protocols, Multiple Granularity, Timestamp-Based Protocols, Validation-Based Protocols.

UNIT 5: (~9 lecture Hours)
Recovery System: Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm, Failure with loss of non-volatile storage, Remote Backup systems.
Indexing: Ordered Indices, B+ -Tree Index files.

Text Books:

1. A. Silberschatz, Henry. F. Korth and S. Sudarshan, Data base System Concepts, 6th Edition, McGraw Hill Education (India) Private Limited.
2. C. J. Date, A. Kannan and S. Swami Nadhan, An Introduction to Database systems, 8th Edition, Pearson Education.

Reference Books:

1. Raghu Ramakrishnan and Johannes Gehrke, Data base Management Systems, 3rd Edition, McGraw Hill Education (India) Private Limited.
2. R Elmasri and Shamkant B. Navathe, Database Systems, 6th Edition, Pearson Education.

Online Resources:

1. https://www.w3schools.in/
2. https://www.tutorialspoint.com/
3. https://beginnersbook.com/2015/04/dbms-tutorial/
4. https://www.coursera.org/courses?query=database
5. https://onlinecourses.nptel.ac.in/noc18_cs15
6. https://online.stanford.edu/course/databases-self-paced

Course Outcomes:

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

1. Understand concepts and the applications of database systems and ability to implement in real time applications.
2. Construct an Entity-Relationship (E-R) model from specifications and transform to relational model.
3. Demonstrate the basic concepts of relational database management system and construct unary/binary/set/aggregate queries in Relational Algebra and in SQL.
4. Apply normalization on database.
5. Understand principles of database transaction management.
6. Understand the storage and recovery of database.

III Year B.Tech. II-Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF CSE (ARTIFICIAL INTELLIGENCE & MACHINE LEARNING)
DEPARTMENT OF CSE (DATA SCIENCE)
DEPARTMENT OF COMPUTER SCIENCE AND TECHNOLOGY

CYBER SECURITY

(Open Elective-2)

Prerequisites: -Nil-

Course Objectives:

1. To demonstrate different types of Cybercrimes, Laws and IT Acts.
2. To introduce different types of Cyber Attacks and steps involved in planning Cybercrimes.
3. To explore various security challenges faced by mobile workforce and their implications under Cybercrime.
4. To introduce Proxy servers, Key loggers, SQL injections and wireless network hacking.
5. To determine various web threats faced by organizations and understand about Social Media Networking.

UNIT 1: (~9 Lecture Hours)
Introduction to Cybercrime: Introduction, Cybercrime – Definitions and origins of the word, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, And Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000 - Hacking and the Indian Law(s), A Global Perspective on Cybercrimes – Cybercrime and the Extended Enterprise.

UNIT 2: (~10 Lecture Hours)
Cyber Offenses: How Criminals Plan Them: Introduction – Categories of Cybercrime, How Criminals plan the Attacks – Reconnaissance, Passive Attacks, Active Attacks, Scanning and Scritinizing Gathered Information, Attack, Social Engineering, Cyber stalking – Types, Cases reported on Cyberstalking, Working of Stalking, Real-Life incident of Cyberstalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

UNIT 3: (~9 Lecture Hours)
Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones.
Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

UNIT 4: (~10 Lecture Hours)
Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking – Online Attacks, Offline Attacks, Strong, Weak and Random Passwords, Keyloggers and Spywares – Software Keyloggers, Hardware Keyloggers, Antikeylogger, Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks – DoS Attacks, Classification, Types and Levels, Tools used to launch DoS attack, DDoS Attacks, How to protect from DoS/DDoS Attacks, SQL Injection, Buffer Overflow.

UNIT 5: (~10 Lecture Hours)
Cyber Security: Organizational Implications Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications.
Social Media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

Text Books:
1. Nina Godbole and Sunil Belapure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley INDIA.

Reference Books:
1. James Graham, Richard Howard and Ryan Otson, Cyber Security Essentials, CRC Press.
2. Chwan-Hwa (john) Wu and J.David Irwin, Introduction to Cyber Security, CRC Press T&F Group.

Online Resources:
1. https://www.open.edu/openlearn/futurelearn/cyber-security
2. https://www.cybrary.it/
3. https://www.cybersecurityeducation.org/resources/
4. https://www.onlinecourses.nptel.ac.in/
5. https://www/coursera.org/

Course Outcomes:
After completion of the course, students will be able to
1. Understand the evolution of Internet in the context of emerging Cyber threats and their laws.
2. Distinguish and classify the forms of Cybercriminal activities and Social Engineering methods used to undertake crimes.
3. Apply risk management policies to protect organization's critical information and assets.
4. Analyse the tools and methods used in Cybercrime.
5. Understand the Security challenges for mobile and wireless devices.
6. Assess the Cybercrime scenarios in India, Global and Legal Perspectives.

III Year B.Tech. II-Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING/
DEPARTMENT OF ELECTRONICS AND TELEMATICS ENGINEERING

PRINCIPLES OF ELECTRONIC COMMUNICATIONS

(Open Elective -2)

Prerequisites: -Nil-

Course Objectives:
1. Introduce the students to modulation and various analog modulation schemes.
2. Distinguish between Pulse, Analog and Digital Communication systems.
3. Analyse the concepts of satellite, optical communications.
4. Understand and compare cellular and telecommunication system concepts.

UNIT 1: (~08 Lecture Hours)
Introduction: Need for Modulation, Frequency translation, Electromagnetic spectrum, Gain, Attenuation and decibels.

UNIT 2: (~10 Lecture Hours)
Simple description on Modulation: Analog Modulation- Amplitude Modulation Fundamentals, Amplitude Modulator and Demodulator Circuits, Fundamentals of Frequency Modulation, Transmission of Binary data in communication system-Principles of Digital transmission, Transmission efficiency, modern concepts, wide band modulation.

UNIT 3: (~10 Lecture Hours)
Satellite Communication: Satellite Orbits, satellite communication systems, satellite subsystems, Ground Stations Satellite Applications, Global Positioning systems.

UNIT4: (~10 Lecture Hours)
Optical Communication: Optical Principles, Optical Communication Systems, Fiber – Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

UNIT 5: (~10Lecture Hours)
Telecommunication Systems: Telephones Telephone system, Facsimile, Internet Telephony. Cellular Communications: Cell phone technologies- Cellular telephone systems, Mobile phone systems, Digital cell phone systems (2G,2.5G,UMTS 3G,4G).

Text Books:
1. Louis E. Frenzel -Principles of Electronic Communication Systems, 3rd Edition, McGraw Hill publications, 2008.

Reference Books:
1. Theodore S. Rappaport, Wireless Communications – Principles and practice, Prentice Hall, 2002.
2. Roger L. Freeman, Fundamentals of Telecommunications, 2nd Edition, Wiley Publications.

Online course:
https://nptel.ac.in/courses/108104098/

Course Outcomes:

After completion of the course, students will be able to

1. Analyze the basic concepts of modulation and understand the different kinds of analog modulation techniques.
2. Understand and analyze the different types of pulse analog and digital modulation systems.
3. Describe the Telephone systems and network fundamentals.
4. State the operative physical principle of launching satellites and explain the concept & operation of GPS.
5. Comprehend about the principle of optical communication system, functioning of optical cables and wave division multiplexing.
6. Describe the cell phone operational concepts.

III Year B.Tech. II-Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

RENEWABLE ENERGY SOURCES
(Open Elective-2)

Prerequisites: -Nil-

Course Objectives:
1. Various renewable energy resources available at a location and assessments of its potential, using tools and techniques.
2. Solar energy radiation, its interactions, measurement and estimation.
3. Site selection for wind turbines, wind systems, measurements and instrument.
4. Geothermal, wave, tidal and OTEC resources, site selection.

UNIT 1: (~6 Lecture Hours)
Introduction to Renewable Energy Sources: Definition, Concepts of NCES, Limitations of RES, Criteria for assessing the potential of NCES, Classification of NCES, Solar, Wind, Geothermal, Biomass, Ocean energy sources, Comparison of these energy sources.
Solar energy: Solar radiation spectrum - Extraterrestrial and terrestrial solar radiation, solar constant -Radiation measurement - Instruments for measuring solar radiation and Sun shine, solar radiation data.

UNIT 2: (~10 Lecture Hours)
Solar Energy Collection, Storage and Applications: Energy Collection: Flat plate and Concentrating collectors, their performance analysis and Classification of Concentrating collectors, Energy Storage: Sensible heat, Latent heat, Stratified storage - Solar ponds. Applications: Heating techniques, Cooling techniques, Solar Distillation and Drying.
Solar Photovoltaic Generation: PV Generation, Photovoltaic energy conversion – Operating principle, Photovoltaic cell concepts, Cell, module, array, Series and parallel connections, Potential of India in Solar energy utilization.

UNIT 3: (~10 Lecture Hours)
Wind Energy and Biomass: Wind energy: Power in Wind, Betz criteria, Site selection, Types of wind mills, Characteristics of wind generators, Potential of India in Wind Energy utilization.
Bio-mass: Principles of Bio-Conversion, Anaerobic, Aerobic digestion, Types of Bio-gas digesters, Pyrolysis, Applications - Bio gas, Wood stoves, Bio diesel, Economic aspects.

UNIT4: (~8 Lecture Hours)
Geothermal Energy and Ocean Energy: Geothermal energy: Resources, Methods of harnessing the energy – Introduction to Thermo dynamic Cycles- Potential of India in Geothermal energy options.
Ocean energy: OTEC - Principle of utilization, setting up of OTEC plants, Thermodynamic cycles involved in OTEC. Tidal and wave energy – Potential and conversion techniques, Mini-hydel power plants and their economics in India.

UNIT 5: (~ 8 Lecture Hours)
Direct Energy Conversion: Direct Energy Conversion (DEC), Need for DEC, Types of DEC - Fuel Cells, working of hydrogen fuel cell Magneto Hydro Dynamic Energy Conversion (MHD), Thermo Electric and Thermo Ionic Conversion (elementary treatment only), Working Principle, Advantages and Disadvantages. Combined cycle and Co-generation.

Text Books:

1. G.D. Rai, Non-Conventional Energy Sources, 5th Edition, Khanna Publishers, 2009.
2. D.P.Kothari, K.C.Singhal and Rakesh Ranjan, Renewable Energy Sources and Emerging Technologies, 2nd Edition, P.H.I., 2014.
3. Twidell & Wier, Renewable Energy Resources, 3rd Edition, CRC Press (Taylor & Francis), 2006.

Reference Books:

1. Tiwari, Ghosal, Renewable Energy Resources, Narosa Publications, 2005.
2. Sukhatme.S.P, Solar Energy: Principles of Thermal Collection and Storage, 3rd Edition, Tata McGraw Hill, 2008.

Course Outcomes

After completion of this course, students should able to

1. Estimate the solar energy, Utilization of solar energy, Principles involved in solar energy collection and conversion of it to electricity generation.
2. Explore the concepts involved in wind energy conversion system by studying its components, types and performance.
3. Understand the concept of Biomass energy resources and their classification, types of biogas Plants- applications.
4. Acquire the knowledge on Geothermal energy and it's harnessing methods.
5. Illustrate ocean energy and explain the operational methods of their utilization.
6. Describe the concept of direct energy conversion and their types and working principle.

III Year B.Tech. II-Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF MECHANICAL ENGINEERING

OPERATIONS RESEARCH
(Open Elective-2)

Prerequisites: - Nil-

Course Objectives:
1. Study the linear programming and dynamic programming techniques used for business and engineering applications.
2. Know about the inventory, Game theory and replacement theory applications in real world.

UNIT 1: (~8 Lecture Hours)
Introduction to Operations Research: Basics definition, scope, objectives, phases, models and limitations of Operations Research. Linear Programming Problem-Formulation of LPP, Graphical solution of LPP. Simplex Method, Artificial variables, big-M methods, Special cases in LP-Degeneracy, unbounded, infeasibility & alternative optima

UNIT 2: (~8 Lecture Hours)
Transportation Problem: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions-Northwest corner rule, Least cost method and Vogel's approximation method. Optimality test by MODI method & stepping stone method.

UNIT 3: (~8 Lecture Hours)
Assignment Model: Formulation, Hungarian method for optimal solution. Solving unbalanced Assignment problem.
Sequencing Models. Solution of sequencing Problem-Processing n jobs through 2 Machines-Processing n jobs through 3 Machines-Processing n jobs through m Machines. Processing 2 jobs through m-machines.

UNIT 4: (~8 Lecture Hours)
Dynamic Programming: Characteristics of Dynamic programming. Dynamic Programming approach for Coach/Shortest Path and cargo loading problems.
Inventory Models: Inventory costs. Models with deterministic demand- Model (a) Demand rate uniform and production rate infinite, Model (b) Demand rate uniform and production rate finite.

UNIT 5: (~8 Lecture Hours)
Games Theory: Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, and value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point-mixed strategy for 2*2 games.
Replacement Models: Replacement of items that deteriorate whose maintenance costs increase with time without change in the money value, Replacement of items that fail suddenly: Individual Replacement policy, Group Replacement policy.

Text Books:
1. P.SankaraIyer, Operations Research, Tata Mcgraw-Hill, 2008.
2. A.M. Natarajan, P. Balasubramani and A. Tamilarasi, Operations Research, Pearson Education, India, 2012.
3. Hamdy A Taha, Operations Research an Introduction, Pearson Education, 2010.

Reference Books:

1. S.D. Sharma, Operations Research Theory Methods and Applications, Kedarnath Ramnath Publishers, 2015.
2. P. K. Gupta and D. S. Hira, Operations Research, S. Chand & Co., 2014.
3. J K Sharma, Operations Research Problems and Solutions, 3rd Edition, Macmillan India Ltd, 2008.

Online Resources:

1. IOR Tutorials(Interactive Operations Research Tutorial)
2. http://www.nptel.ac.in

Course Outcomes:

After completion of the course, students will be able to

1. Apply linear programming models to several Engineering Applications.
2. Use several other techniques like Transportation, Assignment and Sequencing Models in the real world applications.
3. Study selected Dynamic Programming models for real world situations.
4. Apply simple mathematical models in Inventory into the real Engineering Applications.
5. Solve Game theory problems related to business applications.
6. Develop optimum replacement policy.

III Year B.Tech. II-Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF HUMANITIES & MATHEMATICS

BEHAVIOURAL SKILLS AND PROFESSIONAL COMMUNICATION
(Open Elective-2)

Prerequisites: - Nil-

Course Objectives:
1. To achieve the desired life skills and social skills in their workplace.
2. To enable the students to handle and to overcome the professional challenges and conflicts in a working environment.
3. To facilitate the students to understand and develop their managerial skills in a professional environment.
4. To help the students understand professional and cross cultural communication through digital technologies.
5. To develop critical thinking skills for speech and writing.

UNIT 1: (∼09 Lecture Hours**)**
LIFE SKILLS
Essentials of desirable social skills and presentability skills professionally – Confidence building – Self-esteem– Positive attitude – Assertiveness – Professional etiquette and manners – Johari Window.
Unit Objective: To impart Life Skills like confidence building, self-esteem, positive attitude by using case studies employing both speech and writing skills.

UNIT 2: (∼10 Lecture Hours**)**
CRITICAL THINKING SKILLS
Decision Making - Problem Solving – Negotiation - Conflict resolution and Creative thinking – Blooms Taxonomy.
Unit Objective: To develop thinking skills through Blooms Taxonomy by using case studies employing both speech and writing skills.

UNIT 3: (∼10 Lecture Hours**)**
MANAGERIAL SKILLS
Time Management – Stress Management – Crisis Management – Conflict Management – Relationship Management.
Unit Objective: To enable students to be resilient through awareness of Managerial Skills by using case studies employing both speech and writing skills.

UNIT 4: (∼10 Lecture Hours**)**
PROFESSIONAL SKILLS
Digital Communication – Social Networking – Cross Cultural and Cross Functional Communication.
Unit Objective: To sensitize students to Professional Skills in the context of Engineering and Technology by using case studies employing both speech and writing skills.

UNIT 5: (∼09 Lecture Hours**)**
HUMAN VALUES AND PROFESSIONAL ETHICS
Professional Codes of Ethics: Importance and Impact – Ethical Challenges and Conflicts – Moral Issues and dilemmas - Professional Etiquette and Netiquette.
Unit Objective: To impart Human Values in general and in the context of corporate culture and expectations by using case studies employing both speech and writing skills.

Reference Books:

1. Meenakshi Raman and Shalini, Softskills: Key to success in workplace and life, Cengage Publications, 2018.
2. Barun, K. Mitra, Personality Development and Soft Skills, Oxford University Press, 2nd Edition, 2016.
3. Sailesh Sen Gupta, Business and Managerial Communication, PH1 Learning Pvt. Ltd., 2011.

Online Courses:

1. https://onlinecourses.nptel.ac.in/noc19_hs11/preview
2. https://onlinecourses.nptel.ac.in/noc19_mg03/preview
3. CEMCA – Life Skills for Engineers.

Course Outcomes:

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

1. Communicate with more confidence and self-esteem.
2. Give better presentation and explanation using digital aids and tools.
3. Perform effectively and efficiently in the work place environment.
4. Exhibit better tolerance and receptiveness in understanding and accepting diversity.
5. Apply higher thinking order in the self-development process.
6. Equip oneself to handle the work related challenges and conflicts professionally.

III Year B.Tech. II-Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF HUMANITIES & MATHEMATICS

INTELLECTUAL PROPERTY RIGHTS
(Open Elective-2)

Prerequisites: -Nil-

Course Objectives:
1. To educate the importance of IPR in Engineering
2. To enlighten the various types of IP's and their protection.
3. To maintain IPR's for Business sustainability.

UNIT 1: (~ 9 Lecture Hours)
Introduction to Intellectual property
Intellectual property: Introduction – Features - Types of Intellectual property - International organizations - Agencies and treaties, Conventions – Importance of Intellectual property rights.

UNIT 2: (~ 8 Lecture Hours)
Patents: Concept of Patent – Duration – Patent Process – Patent searching process – Procedure for filling Application of Patents - Ownership, Transfer, Assignment and Licensing of Patent – Remedies for Infringement of Patents.

UNIT 3: (~ 10 Lecture Hours)
Copyrights and Trademarks
Copyrights – Fundamental of Copy right law - Originality of material- Rights of Reproduction - Rights to perform the work publicly - Copyright Ownership issues - Copyright registration - Notice of Copyright - Remedies for infringement in Copyrights.
Trademarks – Purpose and functions of Trademarks - Acquisition of Trademark rights - Protectable matter - Selecting and evaluating Trademark - Trademarks registration process – Remedies for infringement in Trade marks.

UNIT 4: (~ 8 Lecture Hours)
Industrial Designs: Assignment of Design – Essential requirement of Registration – Registration Process of Industrial Designs – Benefits of registration – Assignment, Transmission and Licensing of Industrial Designs - Remedies for infringement of Designs.

UNIT 5: (~ 10 Lecture Hours)
Trade Secrets: Trade secret law – determinants of Trade secret status - Liability for misappropriations of Trade Secrets – Protection for submission - Trade secret litigation – Unfair competition – Interface between Intellectual Property Rights and Competition – Safeguards against Unfair competitions.
Intellectual property audits: Types of IP Audit – Procedure of Preparing Audit – Auditing IP Assets.

Text Books:
1. Deborah. E. Bouchoux, Intellectual property right, 1st Edition, Cengage learning, 2015.
2. Prabuddha Ganguli, Intellectual property right – Unleashing the knowledge economy, 1st Edition, Tate McGraw Hill Publishing company ltd., 2015.

Reference Books:

1. Kompal Bansal and Parikshit Bansal, Fundamentals of Intellectual property for Engineers, 1st Edition, BS Publications, 2015.

Online Resources:

1. https://www.icsi.edu/media/webmodules/publications/9.4%20Intellectual%20Property%20Rights.pdf
2. Introduction on Intellectual Property to Engineers and Technologists https://nptel.ac.in/courses/109105112/

Course Outcomes:

After completion of the course, student will be able to

1. Understand the dynamics and legalistic framework of IPR's.
2. Acquaint with securing patents and its protection.
3. Seize the dimensions of Copy right protection.
4. Realize the eminence of Trade Marks in growth of business.
5. Essentials of safeguarding Industrial designs.
6. Sustentation of Trade Secrets and aspects of IP audit.

IV Year B.Tech. I Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING/
DEPARTMENT OF INFORMATION TECHNOLOGY

CYBER SECURITY

(Open Elective-3)

Prerequisites: -Nil-

Course Objectives:

1. To demonstrate different types of Cybercrimes, Laws and IT Acts.
2. To introduce different types of Cyber Attacks and steps involved in planning Cybercrimes.
3. To explore various security challenges faced by mobile workforce and their implications under Cybercrime.
4. To introduce Proxy servers, Key loggers, SQL injections and wireless network hacking.
5. To determine various web threats faced by organizations and understand about Social Media Networking.

UNIT 1: (~9 Lecture Hours)
Introduction to Cybercrime: Introduction, Cybercrime – Definitions and origins of the word, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, And Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000 - Hacking and the Indian Law(s), A Global Perspective on Cybercrimes – Cybercrime and the Extended Enterprise.

UNIT 2: (~10 Lecture Hours)
Cyber Offenses: How Criminals Plan Them: Introduction – Categories of Cybercrime, How Criminals plan the Attacks – Reconnaissance, Passive Attacks, Active Attacks, Scanning and Scritinizing Gathered Information, Attack, Social Engineering, Cyber stalking – Types, Cases reported on Cyberstalking, Working of Stalking, Real-Life incident of Cyberstalking, Cybercafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

UNIT 3: (~9 Lecture Hours)
Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones.
Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

UNIT 4: (~10 Lecture Hours)
Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking – Online Attacks, Offline Attacks, Strong, Weak and Random Passwords, Keyloggers and Spywares – Software Keyloggers, Hardware Keyloggers, Antikeylogger, Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks – DoS Attacks, Classification, Types and Levels, Tools used to launch DoS attack, DDoS Attacks, How to protect from DoS/DDoS Attacks, SQL Injection, Buffer Overflow.

UNIT 5: (~10 Lecture Hours)
Cyber Security: Organizational Implications Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications.
Social Media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

Text Books:
1. Nina Godbole and Sunil Belapure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley INDIA.

Reference Books:
1. James Graham, Richard Howard and Ryan Otson, Cyber Security Essentials, CRC Press.
2. Chwan-Hwa (john) Wu and J.David Irwin, Introduction to Cyber Security, CRC Press T&F Group.

Online Resources:
1. https://www.open.edu/openlearn/futurelearn/cyber-security
2. https://www.cybrary.it/
3. https://www.cybersecurityeducation.org/resources/
4. https://www.onlinecourses.nptel.ac.in/
5. https://www/coursera.org/

Course Outcomes:
After completion of the course, students will be able to
1. Understand the evolution of Internet in the context of emerging Cyber threats and their laws.
2. Distinguish and classify the forms of Cybercriminal activities and Social Engineering methods used to undertake crimes.
3. Apply risk management policies to protect organization's critical information and assets.
4. Analyse the tools and methods used in Cybercrime.
5. Understand the Security challenges for mobile and wireless devices.
6. Assess the Cybercrime scenarios in India, Global and Legal Perspectives.

IV Year B. Tech. I-Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING/
DEPARTMENT OF INFORMATION TECHNOLOGY

PYTHON PROGRAMMING

(Open Elective-3)

Prerequisites: -Nil-

Course Objectives:

1. To be able to introduce core programming basics and program design with functions using Python programming language.
2. To understand a range of Object-Oriented Programming, as well as in-depth data and information processing techniques.
3. To understand the high-performance programs designed to strengthen the practical expertise.

UNIT 1: (~ 12 Lecture Hours)
Introduction to Python Programming: Using Python, The IDLE Programming Environment, Input and Output Processing, Displaying Output with the Print Function, Comments, Variables, Reading Input from the Keyboard, Performing Calculations.
More about Data Output: New line, Item Separator, Escape Characters, Formatting parameters.
Decision Structures and Boolean Logic: if, if-else, if-elif-else Statements, Nested Decision Structures, Comparing Strings, Logical Operators, Boolean Variables.
Repetition Structures: Introduction, while loop, for loop, Sentinels, Input Validation Loops, Nested Loops.

UNIT 2: (~ 9 Lecture Hours)
Functions: Introduction, Defining and Calling a Function, Designing a Program to Use Functions, Local Variables, Passing Arguments to Functions, Global Variables and Global Constants, Value-Returning Functions Generating Random Numbers, Writing Our Own Value-Returning Functions, The math Module, Random Module, Time Module and Storing Functions in Modules.

UNIT 3: (~ 10 Lecture Hours)
Lists and Tuples: Sequences, Introduction to Lists, List slicing, Finding Items in Lists with the in Operator, List Methods and Useful Built-in Functions, Copying Lists, Processing Lists, Two-Dimensional Lists, Tuples.
Strings: Basic String Operations, String Slicing, Testing, Searching and Manipulating Strings.
Dictionaries and Sets: Dictionaries, Sets, Serializing Objects.
Recursion: Introduction, Problem Solving with Recursion, Examples of Recursive Algorithms.

UNIT 4: (~ 9 Lecture Hours)
Python File Input-Output: Opening and Closing file, various types of file modes, reading and writing to files, manipulating directories
Exception Handling: What is Exception, various keywords to handle exception- try, catch, except, else, finally, raise.
Regular Expressions: Concept of regular expression, various types of regular expressions, using match function.

UNIT 5: (~ 8 Lecture Hours)
GUI Programming: Graphical User Interfaces, Using the tkinter Module, Display text with Label Widgets, Organizing Widgets with Frames, Button Widgets and Info Dialog Boxes, Getting Input with Entry Widget, Using Labels as Output Fields, Radio Buttons, Check Buttons.
Introduction to plotting in Python: Basic Plots- Line and Scatter Plot, Histograms and plotting data contained in files.

Text Books:
1. Tony Gaddis, Starting out with Python, 4th Edition, Pearson, 2017.
2. Kenneth A. Lambert, Fundamentals of Python, Delmar Cengage Learning, 2013.
3. Charles Dierbach, Introduction to Computer Science using Python, Wiley, 2013.

Reference Books:
1. James Payne, Beginning Python using Python 2.6 and Python 3, wrox programmer to programmer, 2010.
2. Paul Gries, Practical Programming: An Introduction to Computer Science using Python, 3rd Edition, 2016.
3. Clinton W. Brownley, Foundations for Analytics with Python, 1st Edition, O'Rielly Media, 2016.

Online Resources:
1. https://www.python.org/
2. https://www.coursera.org/learn/python
3. https://learnpythonthehardway.org/book/
4. https://www.coursera.org/specializations/python
5. https://www.learnpython.org/
6. https://www.cs.uky.edu/~keen/115/Haltermanpythonbook.pdf

Course Outcomes:
After completion of the course, students will be able to
1. Gain knowledge on the basic principles of Python programming language.
2. Understand different Decision Making statements and Functions.
3. Apply the knowledge of data structures like Lists, Dictionaries and sets.
4. Understand and summarize different File and exception handling operations.
5. Implement object oriented concepts.
6. Design GUI applications using Python.

IV Year B. Tech. I-Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING/
DEPARTMENT OF INFORMATION TECHNOLOGY

ANDROID PROGRAMMING

(Open Elective-3)

Prerequisites: -Nil-

Course Objectives:

1. To demonstrate their understanding of the fundamentals of Android operating systems.
2. To demonstrate their skills of using Android software development tools.
3. To demonstrate their ability to develop software with reasonable complexity on mobile platform.
4. To demonstrate their ability to deploy software to mobile devices.
5. To demonstrate their ability to debug programs running on mobile devices.

UNIT 1: (~9 Lecture hours)
Introduction to Android Operating System: Android OS design and Features – Android development framework, SDK features, Installing and running applications on Eclipse platform, Creating AVDs, Types of Android applications, Best practices in Android programming, Android tools.
Android application components – Android Manifest file, Externalizing resources like values, themes, layouts, Menus etc., Resources for different devices and languages, Runtime Configuration Changes.
Android Application Lifecycle– Activities, Activity lifecycle, activity states, monitoring state changes.

UNIT 2: (~9 Lecture hours)
Android User Interface: Measurements – Device and pixel density independent measuring units.
Layouts – Linear, Relative, Grid and Table Layouts.
User Interface (UI) Components – Editable and non-editable Text Views, Buttons, Radio and Toggle Buttons, Checkboxes, Spinners, Dialog and pickers.
Event Handling – Handling clicks or changes of various UI components.
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, Multi-screen Activities.

UNIT 3: (~9 Lecture hours)
Intents and Broadcasts: Intent – Using intents to launch Activities, Explicitly starting new Activity, Implicit Intents, Passing data to Intents, Getting results from Activities, Native Actions, using Intent to dial a number or to send SMS.
Broadcast Receivers – Using Intent filters to service implicit Intents, Resolving Intent filters, finding and using Intents received within an Activity.
Notifications – Creating and Displaying notifications, Displaying Toasts.

UNIT 4: (~9 Lecture hours)
Persistent Storage: Files – Using application specific folders and files, creating files, reading data from files, listing contents of a directory Shared Preferences – Creating shared preferences, saving and retrieving data using Shared Preference.
Database – Introduction to SQLite database, creating and opening a database, creating tables, inserting retrieving and deleting data, Registering Content Providers, Using content Providers. (insert, delete, retrieve and update)

UNIT 5: (~9 Lecture hours)
Advanced Topics: Alarms – Creating and using alarms.
Using Internet Resources – Connecting to internet resource, using download manager.
Location Based Services – Finding Current Location and showing location on the Map, updating location.

Text Books:
1. Reto Meier, Professional Android 4 Application Development, Wiley India, (Wrox), 4th Edition, John Wiley & Sons, Inc, 2012.
2. James C Sheusi, Android Application Development for Java Programmers, Cengage Learning, Course Technology, a part of Cengage Learning, 2013.

Reference Books:
1. Wei-Meng Lee, Beginning Android 4 Application Development, 4th Edition, Wiley India (Wrox), 2013.

Online Resources:
1. https://developer.android.com/guide
2. https://www.tutorialspoint.com/android/
3. https://developer.android.com/studio
4. https://nptel.ac.in/courses/106106147/6
5. https://in.udacity.com/course/new-android-fundamentals--ud851
6. https://medium.com/@tristaljing/10-best-app-development-courses-for-beginners-and-get-a-job-d84dbf34b101

Course Outcomes:
After completion of the course, students will be able to
1. Describe Android platform, Architecture and features.
2. Design User Interface and develop activity for Android App.
3. Use Intent, Broadcast receivers and Internet services in Android App.
4. Design and implement Database Application and Content providers.
5. Use multimedia, camera and Location based services in Android App.
6. Discuss various security issues in Android platform.

IV Year B.Tech. I -Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF CSE (ARTIFICIAL INTELLIGENCE & MACHINE LEARNING)
DEPARTMENT OF CSE (DATA SCIENCE)

DISTRIBUTED AND CLOUD COMPUTING

(Open Elective-3)

Prerequisites: -Nil-

Course Objectives:

1. To gain understanding of Distributed Computing & Cloud Computing Principles.
2. To describe various Cloud technologies and Services.
3. To describe Management Strategies and Common Standards of Cloud Computing.

UNIT 1: (~ 9 Lecture Hours)
Principles of Parallel & Distributed Computing - Eras of Computing, Parallel Vs Distributed Computing, Elements of Parallel & Distributed Computing, Technologies for Distributed Computing.
System Models for Distributed & Cloud Computing - Cluster of Cooperative Computers, Grid Computing Infrastructure, Peer-to-Peer Network Families, Cloud Computing over the Internet, Performance, Security & Energy Efficiency.

UNIT 2: (~ 9 Lecture Hours)
Introduction- Cloud computing at a glance, Historical developments, Building cloud computing environments.
Cloud Computing Architecture - The cloud reference model, Types of clouds, Economics of the cloud, Open challenges.

UNIT 3: (~ 9 Lecture Hours)
Virtualization - Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Technology examples- Xen, VMware, Microsoft Hyper-V. Migrating into a Cloud, Virtual Machines Provisioning and Migration Services.

UNIT 4: (~ 9 Lecture Hours)
Cloud Platforms in Industry: Amazon web services, Google AppEngine, Microsoft Azure, Aneka-Integration of private and public cloud
Cloud Applications: Scientific applications, Business and consumer applications.

UNIT 5: (~ 9 Lecture Hours)
SLA Management - Traditional Approaches to SLO Management, Types of SLA, Life Cycle of SLA, SLA Management in Cloud, Automated Policy-based Management.
Common Standards in Cloud Computing - The Open Cloud Consortium, Distributed Management Task Force, Standards for Application Developers, Standards for Messaging, Standards for Security.

Text Books:

1. Rajkumar Buyya, Christian Vecchiola and S.Thamarai Selvi, Mastering Cloud Computing: Foundations and Applications Programming, McGraw Hill Education, 2013.
2. Rajkumar Buyya, James Broberg and Andrzej, Cloud Computing: Principles and paradigms Wiley, 2011.
3. John W. Rittinghous and James F. Ransome, Cloud Computing: Implementation, Management, and Security by CRC, 2010.

Reference Books:

1. Kai Hwang, Geoffery C.Fox, Jack J Dongarra and Elsevier, Distributed and cloud computing, 2012.
2. A. Kannammal, Fundamentals of Cloud Computing, CL India, 2015.
3. Tim Mather, Subra Kumaraswamy and Shahed Latif, Cloud Security and Privacy, An Enterprise Perspective on Risks and Compliance. By Publisher: O'Reilly Media 2009.

Online Resources:

1. https://ramslaw.files.wordpress.com/2016/07/0124114547cloud.pdf
2. http://www.chinacloud.cn/upload/2011-07/11073107539898.pdf
3. https://eniac2017.files.wordpress.com/2017/03/distributed-and-cloud-computing.pdf
4. https://aws.amazon.com/
5. https://cloud.google.com/

Course Outcomes:

After completion of the course, students will be able to

1. Illustrate the Principles of Distributed Computing.
2. Articulate the main concepts, key technologies, strengths, and limitations of cloud computing.
3. Illustrate the broad perceptive of cloud architecture and model.
4. Apply and design suitable Virtualization Technology.
5. Explore some important cloud computing driven commercial systems such as Google Apps, Microsoft Azure and Amazon Web Services and other businesses cloud applications.
6. Analyze the various standards for Cloud Computing and Illustrate Management Strategies of Cloud.

IV Year B.Tech. I -Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF COMPUTER SCIENCE AND TECHNOLOGIES

BLOCKCHAIN TECHNOLOGIES
(Open Elective-3)

Prerequisites: -Nil-

Course Objectives:
1. To enable students develop understanding on Blockchain Technology.
2. To equip students with knowledge on cryptocurrencies working.
3. To empower students, gain knowledge on Blockchain implementation technologies.

UNIT 1: (~ 6 Lecture Hours)
Blockchain 101: - The History of blockchain and Bitcoin, Types of blockchain, Consensus.
Decentralization: - Decentralization using Blockchain, Blockchain and Full Ecosystem, Platforms for Decentralization.

UNIT 2: (~ 8 Lecture Hours)
Introducing Bitcoin: - Bitcoin, Digital Keys and Addresses, Transactions, Mining.
Bitcoin Network and Payments: – Wallets.
Alternative Coins: – Theoretical Foundations, Bitcoin limitations, Namecoin, Primecoin, Zcash
Smart Contracts: – Ricardian Contracts.

UNIT 3: (~ 10 Lecture Hours)
Ethereum 101: - The Ethereum network, Components of the Ethereum ecosystem.
Further Ethereum: - Programming Languages-Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols.
Development Tools and Frameworks: - Solidity Language.

UNIT 4: (~ 10 Lecture Hours)
Introducing Web3: - Web3 – Contract Deployment, POST Requests, Development frameworks.
Hyperledger: - Hyperledger as a protocol, The reference architecture,
Fabric-Hyperledger Fabric– Distributed Ledger, Corda.

UNIT 5: (~ 10 Lecture Hours)
Alternative Blockchains: - Blockchains- Kadena, Ripple, Rootstock, Quorum, Tezos, Storj, Maidsafe, BigchainDB, Multichain, Tendermint.
Scalability and Other Challenges: -Scalability, Privacy.
Current Landscape and What's Next: – Blockchain Research, Notable Projects, Miscellaneous Tools.

Text Books:
1. Imran Bashir, Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained, 2nd Edition, Packt Publishing, 2018.

Reference Books:

1. Arshdeep Bahga and Vijay Madisetti, Blockchain Applications: A Hands On Approach, VPT, 2017.
2. Chandramouli Subramanian, Asha A George, Abilash KA and MeenaKarthikeyan, Blockchain Technology, Universities Press, 2020.
3. Elad Elrom, The Blockchain Developer: A Practical Guide for Designing, Implementing, Publishing, Testing and Securing Distributed Blockchain-based projects, Springer Nature B.V, 2019.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105184/
2. https://github.com/rddill-IBM/ZeroToBlockchain
3. tech.seas.harvard.edu/free-blockchain
4. https://www.codecademy.com/learn/introduction-to-blockchain/modules/fundamental-blockchain-concepts
5. The Basics of Blockchain & Bitcoin Fundamentals Course | Udemy

Course Outcomes:

After completion of this course, students will be able to

1. Acquire understanding on Blockchain Technology built-in way.
2. Interpret how various cryptocurrencies work.
3. Articulate Ethereum Blockchain for developing smart contracts.
4. Apprehend knowledge on Web3 and Hyperledger Fabric for decentralized apps.
5. Exemplifying different alternative and emerging Blockchains.
6. Understand real-time usage of Blockchain.

IV Year B.Tech. I-Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING/ DEPARTMENT OF ELECTRONICS AND TELEMATICS ENGINEERING

TELECOMMUNICATION SWITCHING SYSTEM

(Open Elective-3)

Prerequisites: -Nil-

Course Objectives:

1. To expose through the evolution of switching systems from electromechanical systems to stored-program-controlled digital systems.
2. To provide knowledge to the students regarding design and performance analysis of electronic space division switching systems.
3. To provide knowledge to the students regarding design and performance analysis of time division switching systems.
4. To train the students about basic concepts of Telephone Networks.
5. To inculcate students on various traffic engineering concepts.

UNIT 1: (~10 Lecture Hours)
Telecommunication Switching Systems: Introduction, Evolution of Telecommunications, Basics of a switching system, Crossbar Switching, Principles of Crossbar Switching, Crossbar Switch Configuration, Crosspoint Technology, Crossbar Exchange Organization.

UNIT 2: (~8 Lecture Hours)
Electronic Space Division Switching: Stored Program Control, Centralized SPC, Distributed SPC, Software Architecture, Application Software, Enhanced services, Two-Stage Networks, Three-Stage Networks, n-Stage Networks.

UNIT 3: (~8 Lecture Hours)
Time Division Switching: Basic Time Division Space Switching, Basic Time Division Time Switching, Time Multiplexed Space Switching, Time Multiplexed Time Switching, Combination Switching, Three Stage Combination Switching, n - Stage Combinational Switching.

UNIT 4: (~10 Lecture Hours)
Telecommunications Traffic : Introduction, The Unit of Traffic, Congestion, Traffic Measurement, A Mathematical Model, Lost-Call Systems- Theory, Traffic Performance, Loss Systems in Tandem, Use of Traffic Tables, Queuing Systems-The Second Erlang Distribution, Probability of Delay.

UNIT 5: (~10 Lecture Hours)
Telephone Networks : Subscriber loop systems, Switching hierarchy and routing, Transmission plan, Transmission systems, Numbering plan, Charging plan, Signaling techniques: In channel signaling, Common channel signaling.

Text Books:

1. Thyagarajan Viswanath, Tele Communication Switching System and Networks, PHI, 2000.
2. J. E Flood, Telecommunications Switching and Traffic Networks, Pearson Education, 2006.

Reference Books:

1. J. Bellamy, Digital telephony, 2nd Edition, John Wiley, 2001.
2. Achyut. S.Godbole, Data Communications & Networks, TMH, 2004.
3. H. Taub and D. Schilling, Principles of Communication Systems, TMH, 2nd Edition, 2003.
4. S.Keshav, An Engineering approach to computer networking, Addison Wesely.

Online References:

1. https://onlinelibrary.wiley.com/doi/book/10.1002/0471208051
2. https://en.wikipedia.org/wiki/Telecommunication

Course Outcomes:

After completion of the course, students will be able to

1. Acquire knowledge about Telecommunication Switching Systems.
2. Understand different Telecommunication switching and signaling methodologies.
3. Apply the concepts to solve the real time telecommunication problems.
4. Analyse the fundamental telecommunication traffic models.
5. Evaluate telecommunication switching systems.
6. Design a telecommunication switching system.

IV Year B.Tech. I-Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

WASTE MANAGEMENT TECHNIQUES AND POWER GENERATION
(Open Elective-3)

Prerequisites: -Nil-

Course Objectives:
1. To classify the sources of solid waste & e-waste.
2. To identify methods of solid waste disposal.
3. To understand various waste management techniques.
4. To study various energy generation methods as per type of waste available locally.
5. To analyze energy generation methods and recycling of waste.

UNIT 1: (~8 Lecture Hours)
Waste Management and Handling: Sources & types of wastes (Industrial, Municipal, Agro, Domestic). Generation of wastes, Pollution standards, Waste characterization. Functional elements of waste management, technological aspects related to waste generation, on site handling, storage, collection, transfer and transport.
Processing techniques and equipment (volume reduction, size reduction, component separation, dewatering, drying).

UNIT 2: (~ 8 Lecture Hours)
Waste Management Issues: Planning, organization & control Hazardous & toxic wastes, hazard & its management, classification, generation, handling, processing and disposal. Industrial safety, Waste disposal, Environmental impact (toxic & non-toxic).

UNIT 3: (~ 10 Lecture Hours)
Conversion Techniques & Methods: Recovery of value added components: Recycling, conversion products and energy
Conversion technologies: Incineration, – principle features of an incinerator – site selection and plant layout of an incinerator - Thermo-chemical conversions.
Biochemical conversion: Biogas & ethanol Conventional Chemical & biological treatment. Power generation & its utilization.

UNIT 4: (~ 8 Lecture Hours)
Processing Techniques and Recovery of Energy: Processing techniques – purposes mechanical volume reduction – necessary equipments – chemical volume reduction – mechanical size reduction selection of equipments – components separation – methods – drying and dewatering. Refusal disposal – various methods.

UNIT 5: (~ 10 Lecture Hours)
Concepts of Land Fill & e-Waste
Concepts of Land Fill: Land Fill method of solid waste disposal, Land fill classification, Types, methods and Sitting consideration, Layout and preliminary design of landfills: Composition, Movement and control of landfill leachate and gases, Environmental monitoring for land fill gases.
e-Waste: e-waste in global context, Environmental concerns, Global trading in hazardous waste, Management of e-waste, e-waste legislation, Government regulations on e-waste management & Recycling.

Text Books:

1. T.V. Ramachandra, Management of Municipal Solid Waste, The Energy and Resources Institute, TERI, 2009.
2. Thomas Christensen, Solid waste technology and Management, 2nd Volume Set., WILEY Publishers, 2011.
3. K. Sasi Kumar and Sanoop Gopi Krishna, Solid Waste Management, PHI Learning Pvt. Ltd, 2009.

Reference Books:

1. Vasudevan Rajaram, Faisal Zia Siddiqui, Sanjeev Agrawal and Mohammad Emran Khan, Solid and Liquid Waste Management: Waste to Wealth, PHI Learning Pvt. Ltd, 2016**.**
2. P. Jayarama Reddy, Energy Recovery from Municipal Solid Waste by Thermal Conversion Technologies, CRC Press, 2016.
3. Ms Bhatt Asheref Illiyan, Solid waste Management: An Indian Perspective, Synergy Books India, 2012**.**

Course Outcomes:

After completion of the course, students will be able to

1. Understand technologies for generation of energy from solid waste.
2. Compare methods of solid waste disposal.
3. Identify sources of energy from waste using various conversion techniques.
4. Analyze methods for waste management.
5. Assess the harmful effects of e-waste.
6. Differentiate between the normal waste and e-waste.

IV Year B.Tech. I-Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF HUMANITIES & MATHEMATICS

INDUSTRIAL MANAGEMENT
(Open Elective-3)

Prerequisites: -Nil-

Course Objectives:
1. To up skill the importance of Productivity in Production Process.
2. To give insights of managing Production activities.
3. To sensitize the importance of Quality.

UNIT 1: (∼08 Lecture Hours)
Introduction to Industrial Management
Industrial Management – Introduction - Need, Scope, Evolution – Industrial Engineering and Management.
Production Management – Plant location – Factors affecting Plant location - Plant Layout – Types of Plant Layout – Product, Process, Fixed Position and Combination Layout.

UNIT 2: (∼07 Lecture Hours)
Production and Productivity
Production – Introduction – Types of Production – Job, Batch and Mass Production – Methods of Production.
Productivity – Concept of Productivity – Production vs Productivity – Objectives – Factors affecting Productivity – Kinds of Productivity – Material, Labour, Capital, Machine and general measure of Productivity (Theory only) – Measures to improve Productivity and its benefits.

UNIT 3: (∼10 Lecture Hours)
Operations and Materials Management
Operations Management – Work study – Introduction – Objectives – Scope of Work study- Method study - Definition - Objectives – Steps of Method study. Work measurement – Definition, objectives and benefits of Work measurements – Time study – Definition – Steps in Time study – Uses of Time study.
Materials Management – Definition – Objectives – Functions – Purchase procedure – ABC analysis – VED Analysis – Economic Order Quantity.

UNIT 4: (∼10 Lecture Hours)
Inventory and Stores Management
Inventory Management – Introduction - Functions of Inventory Control – Advantages of Inventory Control – Methods of Inventory issues – FIFO, LIFO, Simple average and Weighted average methods (simple problems) – Material Resource Planning (MRP) - Enterprise Resource Planning (ERP) – Just in Time (JIT) - Supply Chain Management (SCM)
Stores Management – Stores Keeping – Classification of Stores – Stores Records

UNIT 5: (∼10 Lecture Hours)
Quality Management and Control
Quality Management – Introduction, Evolution, Contributions of Juran, Deming, Crosby, Total Quality Management.
Statistical Quality Control – Advantages of Quality control – Shewart Control Charts for variables - $\bar{x}$ chart and R chart – Attributes – Defective – Defect – Charts for Attributes – P Chart and C Chart (simple problems) - Six Sigma.

Text Books:

1. O.P. Khanna, Industrial Engineering and Management, Dhanpat Rai Publications Pvt. Ltd., 2004.
2. T.R. Banga, NK Agarwal and S.C. Sarma, Industrial Engineering and Management Science, 10th Edition, Khanna Publishers.

Reference Books:

1. Joseph and G. Monks, Operations Management (Theory and Problems), 3rd Edition, Mc. Graw- Hill Series in Management, 1987.
2. NVS Raju, Industrial Engineering & Management, Cengage Learning, 2013.
3. Besterfield, Total Quality Management, Pearson.

Online Resources:

1. Operations Management
   https://onlinecourses.nptel.ac.in/noc18_me26/preview

Course Outcomes:

After completion of the course, student will be able to

1. Organize the activities of Business efficiently.
2. Adapt to appropriate method of production yielding productivity.
3. Identify efficient method of production.
4. Handle inventory efficiently for improving Productivity.
5. Implement and maintain Quality standards in Production.
6. Cohere to dynamic practices to improve Productivity.

IV Year B.Tech. II-Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING/
DEPARTMENT OF INFORMATION TECHNOLOGY

PRINCIPLES OF ARTIFICIAL INTELLIGENCE
(Open Elective- 4)

Prerequisites: -Nil-

Course Objectives:
1. To learn the difference between optimal reasoning vs human like reasoning.
2. To understand the notions of state space representation, uninformed search, informed (heuristic) search.
3. To learn different knowledge representation techniques.
4. To understand the applications of Al: namely Game Playing, Expert Systems, Machine Learning and Natural Language Processing.

UNIT 1: (~ 11 Lecture Hours)
Introduction: History, Foundations of AI, Sub areas of AI, Objectives and Applications of AI.
Intelligent Agent: Agents and Environments and the Structure of Agents.
Solving Problem by Searching: Introduction, General Problem Solving.
Uninformed Search Strategies: Breadth First Search and Depth First Search.
Informed (Heuristic) Search Strategies: Heuristic Function, A* Algorithm and Hill Climbing.

UNIT 2: (~ 10 Lecture Hours)
Game Playing: Optimal Decisions in Games, the Minimax Algorithm, Alpha-Beta Pruning, Constraint Satisfaction Algorithm.
Logic Concepts: Introduction, Propositional Logic, Predicate Logic, Unification Algorithm, Natural Deduction System, Semantic Tableau System in Propositional Logic, Resolution Refutation in Propositional Logic.

UNIT 3: (~ 10 Lecture Hours)
Knowledge Representation: Introduction, Approaches to Knowledge Representation, Knowledge Representation using Semantic Networks and Extended Semantic Networks, Knowledge Representation using Frames.
Expert System and Applications: Introduction, Phases in Building Expert Systems, Expert System Architecture, Expert Systems Vs Traditional Systems, Application of Expert Systems, List of Shells and Tools.

UNIT 4: (~ 9 Lecture Hours)
Uncertainty Measure – Probability Theory: Introduction, Probability Theory, Bayesian Belief Networks, Dempster-Shafer Theory.
Machine Learning: Introduction. Machine Learning Systems. Supervised, Unsupervised Learning and Reinforcement Learning, Learning Decision Trees, Clustering, Support Vector Machines.

UNIT 5: (~ 8 Lecture Hours)
Artificial Neural Networks: Introduction, Artificial Neural Networks, Single- Layer Feed-Forward Networks, Multi-Layer Feed-Forward Networks, Recurrent Networks, Design Issues of Artificial Neural Networks.
Advanced Knowledge Representation Techniques: Case Grammars, Semantic Web.

Natural Language Processing: Introduction, Sentence Analysis Phases, Grammars and Parsers, Types of Parsers.

Text Books:

1. Russell and Norvig, Artificial intelligence, A Modern Approach, Pearson Education, 3rd Edition. 2014.
2. Rich, Knight and Nair, Artificial intelligence, Tata McGraw Hill, 3rd Edition 2009.

Reference Books:

1. Deepak Khemani, A First Course in Artificial Intelligence, McGraw-Hill Education, 2013
2. Saroj Kaushik, Artificial Intelligence, Cengage Learning, 2011D, Samanta, Classic Data Structures, 2nd Edition, PHI.

Online Resources:

1. https://faculty.psau.edu.sa/filedownload/doc-7-pdf a154ffbcec538a4161a406abf62f5b76-original.pdf
2. http://www.vssut.ac.in/lecture_notes/lecture1428643004.pdf
3. http://nptel.ac.in/courses/106105077/
4. https://onlinecourses.nptel.ac.in/noc18_cs18/preview
5. https://www.edx.org/course/artificial-intelligence-ai-columbiax-csmm-101x-4

Course Outcomes:

After completion of the course, students will be able to

1. Understand the basics of AI and knowledge representation using appropriate technique.
2. Apply AI techniques for problem solving using various search and game Playing algorithms.
3. Interpret architectures of different intelligent agents and Expert Systems.
4. Interpret probabilistic and logical reasoning for knowledge.
5. Analyse different Machine Learning approaches for problem solving.
6. Recognize basics of Natural Language Processing.

IV Year B.Tech. II-Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING/
DEPARTMENT OF INFORMATION TECHNOLOGY

CLOUD COMPUTING

(Open Elective- 4)

Prerequisites: -Nil-

Course Objectives:
1. To explain evolving computer model called cloud computing.
2. To introduce the various levels of services that can be achieved by cloud.
3. To describe the security aspects of cloud.

UNIT 1: (~ 9 Lecture Hours)
Introduction: Cloud computing at a glance, Historical developments, Building cloud computing environments.
Cloud Computing Architecture: The cloud reference model, Types of clouds, Economics of the cloud, Open challenges.

UNIT 2: (~ 9 Lecture Hours)
Virtualization: Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Technology examples- Xen, VMware, Microsoft Hyper-V. Migrating into a Cloud, Virtual Machines Provisioning and Migration Services.

UNIT 3: (~ 9 Lecture Hours)
Cloud Platforms in Industry: Amazon web services, Google AppEngine, Microsoft Azure, Aneka-Integration of private and public cloud
Cloud Applications: Scientific applications, Business and consumer applications.

UNIT 4: (~ 9 Lecture Hours)
Security in the Cloud: Cloud Security Challenges, Software-as-a-Service Security.
Secure Distributed Data Storage in Cloud Computing: Cloud Storage: from LANs to WANs, Technologies for Data Security in Cloud Computing.
Data Security in the Cloud: The Current State of Data Security in the Cloud, Cloud Computing and Data Security Risk, Cloud Computing and Identity, The Cloud, Digital Identity, and Data Security, Content Level Security-Pros and Cons.

UNIT 5: (~ 9 Lecture Hours)
SLA Management: Traditional Approaches to SLO Management, Types of SLA, Life Cycle of SLA, SLA Management in Cloud, Automated Policy-based Management.
Common Standards in Cloud Computing: The Open Cloud Consortium, Distributed Management Task Force, Standards for Application Developers, Standards for Messaging, Standards for Security.

Text Books:

1. Rajkumar Buyya, Christian Vecchiola and S. Thamarai Selvi, Mastering Cloud Computing: Foundations and Applications Programming, McGraw Hill Education 2013.
2. Rajkumar Buyya, James Broberg, Andrzej and Wiley, Cloud Computing: Principles and paradigms, 2011.
3. John W. Rittinghouse and James F. Ransome, Cloud Computing: Implementation, Management and Security, CRC, 2010.

Reference Books:

1. Kai Hwang, Geoffery C.Fox and Jack J Dongarra, Distributed and cloud computing, Elsevier, 2012.
2. A. Kannammal, Fundamentals of Cloud Computing, CL India, 2015.
3. Tim Mather, Subra Kumaraswamy and Shahed Latif, Cloud Security and Privacy, An Enterprise Perspective on Risks and Compliance. Publisher: O'Reilly Media 2009.

Online Resources:

1. https://ramslaw.files.wordpress.com/2016/07/0124114547cloud.pdf
2. http://www.chinacloud.cn/upload/2011-07/11073107539898.pdf
3. https://eniac2017.files.wordpress.com/2017/03/distributed-and-cloud-computing.pdf
4. https://aws.amazon.com/
5. https://cloud.google.com/
6. https:// onlinecourses.nptel.ac.in
7. https://coursera.org/learn/cloud-computing

Course Outcomes:

After completion of the course, students will be able to

1. Articulate the main concepts, key technologies, strengths, and limitations of cloud computing.
2. Illustrate the broad perceptive of cloud architecture and model.
3. Apply and design suitable Virtualization concept.
4. Explore some important cloud computing driven commercial systems such as Google Apps, Microsoft Azure and Amazon Web Services and other businesses cloud applications.
5. Assess cloud Storage systems and Cloud security, the risks involved, its impact and develop cloud application.
6. Analyse the various standards for Cloud computing and its management.

IV Year B.Tech. II-Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF CSE (ARTIFICIAL INTELLIGENCE & MACHINE LEARNING)
DEPARTMENT OF CSE (DATA SCIENCE)

DISTRIBUTED AND CLOUD COMPUTING

(Open Elective- 4)

Prerequisites: -Nil-

Course Objectives:
1. To gain understanding of Distributed Computing & Cloud Computing Principles.
2. To describe various Cloud technologies and Services.
3. To describe Management Strategies and Common Standards of Cloud Computing.

UNIT 1: (~ 9 Lecture Hours)
Principles of Parallel & Distributed Computing - Eras of Computing, Parallel Vs Distributed Computing, Elements of Parallel & Distributed Computing, Technologies for Distributed Computing.
System Models for Distributed & Cloud Computing - Cluster of Cooperative Computers, Grid Computing Infrastructure, Peer-to-Peer Network Families, Cloud Computing over the Internet, Performance, Security & Energy Efficiency.

UNIT 2: (~ 9 Lecture Hours)
Introduction- Cloud computing at a glance, Historical developments, Building cloud computing environments.
Cloud Computing Architecture - The cloud reference model, Types of clouds, Economics of the cloud, Open challenges.

UNIT 3: (~ 9 Lecture Hours)
Virtualization - Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Technology examples- Xen, VMware, Microsoft Hyper-V. Migrating into a Cloud, Virtual Machines Provisioning and Migration Services.

UNIT 4: (~ 9 Lecture Hours)
Cloud Platforms in Industry: Amazon web services, Google AppEngine, Microsoft Azure, Aneka-Integration of private and public cloud
Cloud Applications: Scientific applications, Business and consumer applications.

UNIT 5: (~ 9 Lecture Hours)
SLA Management - Traditional Approaches to SLO Management, Types of SLA, Life Cycle of SLA, SLA Management in Cloud, Automated Policy-based Management.
Common Standards in Cloud Computing - The Open Cloud Consortium, Distributed Management Task Force, Standards for Application Developers, Standards for Messaging, Standards for Security.

Text Books:
1. Rajkumar Buyya, Christian Vecchiola and S.Thamarai Selvi, Mastering Cloud Computing: Foundations and Applications Programming, McGraw Hill Education, 2013.
2. Rajkumar Buyya, James Broberg and Andrzej, Cloud Computing: Principles and paradigms Wiley, 2011.
3. John W. Rittinghous and James F. Ransome, Cloud Computing: Implementation, Management, and Security by CRC, 2010.

Reference Books:

1. Kai Hwang, Geoffery C.Fox, Jack J Dongarra and Elsevier, Distributed and cloud computing, 2012.
2. A. Kannammal, Fundamentals of Cloud Computing, CL India, 2015.
3. Tim Mather, Subra Kumaraswamy and Shahed Latif, Cloud Security and Privacy, An Enterprise Perspective on Risks and Compliance. By Publisher: O'Reilly Media 2009.

Online Resources:

1. https://ramslaw.files.wordpress.com/2016/07/0124114547cloud.pdf
2. http://www.chinacloud.cn/upload/2011-07/11073107539898.pdf
3. https://eniac2017.files.wordpress.com/2017/03/distributed-and-cloud-computing.pdf
4. https://aws.amazon.com/
5. https://cloud.google.com/

Course Outcomes:

After completion of the course, students will be able to

1. Illustrate the Principles of Distributed Computing.
2. Articulate the main concepts, key technologies, strengths, and limitations of cloud computing.
3. Illustrate the broad perceptive of cloud architecture and model.
4. Apply and design suitable Virtualization Technology.
5. Explore some important cloud computing driven commercial systems such as Google Apps, Microsoft Azure and Amazon Web Services and other businesses cloud applications.
6. Analyze the various standards for Cloud Computing and Illustrate Management Strategies of Cloud.

IV Year B.Tech. II-Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF COMPUTER SCIENCE AND TECHNOLOGIES

BLOCKCHAIN TECHNOLOGIES
(Open Elective-4)

Prerequisites: -Nil-

Course Objectives:
1. To enable students develop understanding on Blockchain Technology.
2. To equip students with knowledge on cryptocurrencies working.
3. To empower students, gain knowledge on Blockchain implementation technologies.

UNIT 1: (~ 6 Lecture Hours)
Blockchain 101: - The History of blockchain and Bitcoin, Types of blockchain, Consensus.
Decentralization: - Decentralization using Blockchain, Blockchain and Full Ecosystem, Platforms for Decentralization.

UNIT 2: (~ 8 Lecture Hours)
Introducing Bitcoin: - Bitcoin, Digital Keys and Addresses, Transactions, Mining.
Bitcoin Network and Payments: – Wallets.
Alternative Coins: – Theoretical Foundations, Bitcoin limitations, Namecoin, Primecoin, Zcash
Smart Contracts: – Ricardian Contracts.

UNIT 3: (~ 10 Lecture Hours)
Ethereum 101: - The Ethereum network, Components of the Ethereum ecosystem.
Further Ethereum: - Programming Languages-Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols.
Development Tools and Frameworks: - Solidity Language.

UNIT 4: (~ 10 Lecture Hours)
Introducing Web3: - Web3 – Contract Deployment, POST Requests, Development frameworks.
Hyperledger: - Hyperledger as a protocol, The reference architecture,
Fabric-Hyperledger Fabric– Distributed Ledger, Corda.

UNIT 5: (~ 10 Lecture Hours)
Alternative Blockchains: - Blockchains- Kadena, Ripple, Rootstock, Quorum, Tezos, Storj, Maidsafe, BigchainDB, Multichain, Tendermint.
Scalability and Other Challenges: -Scalability, Privacy.
Current Landscape and What's Next: – Blockchain Research, Notable Projects, Miscellaneous Tools.

Text Books:
1. Imran Bashir, Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained, 2nd Edition, Packt Publishing, 2018.

Reference Books:

1. Arshdeep Bahga and Vijay Madisetti, Blockchain Applications: A Hands On Approach, VPT, 2017.
2. Chandramouli Subramanian, Asha A George, Abilash KA and MeenaKarthikeyan, Blockchain Technology, Universities Press, 2020.
3. Elad Elrom, The Blockchain Developer: A Practical Guide for Designing, Implementing, Publishing, Testing and Securing Distributed Blockchain-based projects, Springer Nature B.V, 2019.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105184/
2. https://github.com/rddill-IBM/ZeroToBlockchain
3. tech.seas.harvard.edu/free-blockchain
4. https://www.codecademy.com/learn/introduction-to-blockchain/modules/fundamental-blockchain-concepts
5. The Basics of Blockchain & Bitcoin Fundamentals Course | Udemy

Course Outcomes:

After completion of the course, students will be able to

1. Acquire understanding on Blockchain Technology built-in way.
2. Interpret how various cryptocurrencies work.
3. Articulate Ethereum Blockchain for developing smart contracts.
4. Apprehend knowledge on Web3 and Hyperledger Fabric for decentralized apps.
5. Exemplifying different alternative and emerging Blockchains.
6. Understand real-time usage of Blockchain.

IV Year B.Tech. II-Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING/ DEPARTMENT OF ELECTRONICS AND TELEMATICS ENGINEERING

CELLULAR AND MOBILE COMMUNICATIONS

(Open Elective - 4)

Prerequisite: -Nil-

Course Objectives:

1. To provide the student with an understanding of the Cellular concept, Frequency reuse, Hand-off strategies.
2. To enable the student to analyze and understand wireless and mobile cellular communication systems over a stochastic fading channel.
3. To provide the student with an understanding of Co-channel and Non-Co-channel interferences.
4. To give the student an understanding of cell coverage for signal and traffic, diversity techniques and mobile antennas.
5. To give the student an understanding of frequency management, Channel assignment and types of handoff.

UNIT 1: (~12 Lecture Hours)
Introduction to Cellular Mobile Radio Systems: Limitations of Conventional Mobile Telephone Systems, Basic Cellular Mobile System, First, Second, Third and Fourth Generation Cellular Wireless Systems, Uniqueness of Mobile Radio Environment- Fading - Time Dispersion Parameters, Coherence Bandwidth, Doppler Spread and Coherence Time.
Fundamentals of Cellular Radio System Design: Concept of Frequency Reuse, Co-Channel Interference, Co-Channel Interference Reduction Factor, Desired C/I From a Normal Case in a Omni Directional Antenna System, System Capacity, Trunking and Grade of Service, Improving Coverage and Capacity in Cellular Systems- Cell Splitting, Sectoring, Microcell Zone Concept.

UNIT 2: (~11 Lecture Hours)
Co-Channel Interference: Measurement Of Real Time Co-Channel Interference, Design of Antenna System, Antenna Parameters and Their Effects, Diversity Techniques-Space Diversity, Polarization Diversity, Frequency Diversity, Time Diversity**.**
Non-Co-Channel Interference: Adjacent Channel Interference, Near End Far End Interference, Cross Talk, Effects on Coverage and Interference by Power Decrease, Antenna Height Decrease, Effects of Cell Site Components.

UNIT 3: (~11 Lecture Hours)
Cell Coverage for Signal and Traffic: Signal Reflections in Flat And Hilly Terrain, Effect of Human Made Structures, Phase Difference Between Direct and Reflected Paths, Constant Standard Deviation, Straight Line Path Loss Slope, General Formula for Mobile Propagation Over Water and Flat Open Area, Near and Long Distance Propagation, Path Loss From a Point to Point Prediction Model in Different Conditions, Merits of Lee Model.
Cell Site and Mobile Antennas: Space Diversity Antennas, Umbrella Pattern Antennas, Minimum Separation of Cell Site Antennas, Mobile Antennas**.**

UNIT 4: (~07 Lecture Hours)
Frequency Management and Channel Assignment:
Numbering and Grouping, Setup Access And Paging Channels, Channel Assignments to Cell Sites and Mobile Units, Channel Sharing and Borrowing, Sectorization, Overlaid Cells, Non Fixed Channel Assignment**.**

UNIT 5: (~07 Lecture Hours)
Handoffs and Dropped Calls:
Handoff Initiation, Types of Handoff, Delaying Handoff, Advantages of Handoff, Power Difference Handoff, Forced Handoff, Mobile Assisted and Soft Handoff, Intersystem Handoff, Introduction to Dropped Call Rates and their Evaluation

Text Books:
1. W.C.Y. Lee, Mobile Cellular Telecommunications, 2nd Edition, Mc Graw Hill, 1989.
2. Theodore. S. Rapport, Wireless Communications, 2nd Edition, Pearson Education, 2002.
3. Upena Dalal, Wireless communication and networks, Oxford University press.

Reference Books:
1. Gordon L. Stuber, Principles of Mobile Communications, 2nd Edition, Springer International, 2001.
2. Simon Haykin and Michael Moher, Modern Wireless Communications, Pearson Education, 2005.
3. Asrar U. H. Sheikh, Wireless Communications Theory and Techniques, Springer, 2004.
4. Vijay Garg, Wireless Communications and Networking, Elsevier Publications, 2007.
5. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2005.

Online Resources:
1. https://onlinecourses.nptel.ac.in/noc17_cs37/preview Wireless and Cellular Communication by Prof.R. David Koilpillai.
2. https://nptel.ac.in/courses/117102062/ : Wireless Communication by Dr. Ranjan Bose

Course Outcomes:
After completion of the course, student will be able to
1. Analyze and design wireless and mobile cellular systems.
2. Understand impairments due to multipath fading channel.
3. Understand the fundamental techniques to overcome the different fading effects.
4. Understand Co-channel and Non Co-channel interferences.
5. Familiar with cell coverage for signal and traffic, diversity techniques and mobile antennas.
6. Understanding of frequency management, Channel assignment, and types of handoff.

IV Year B.Tech. II-Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ROBOTICS

(Open Elective- 4)

Prerequisite: -Nil-

Course Objectives:

1. To understand basic concepts of robotics.
2. To learn various sensors and actuators used in the design of robots.
3. To learn various robot programming methods and languages.

UNIT 1: (~8 Lecture Hours)

Introduction: - Basic Concepts such as Definition, brief history, three laws, depth of filed, Robot anatomy, Classification and usage, science and technology of robots, associated parameters: resolution, accuracy, repeatability, dexterity.

UNIT 2: (~8 Lecture Hours)

Sensors for Robots: - Characteristics of sensing devices, Selections of sensors, Classification and applications of sensors. Types of Sensors, Need for sensors and vision system in the working and control of a robot.
Drives: - Types of Drives, Actuators and its selection while designing a robot system. Types of transmission systems.

UNIT 3: (~10 Lecture Hours)

Control Systems: - Types of Controllers, Introduction to closed loop control, second order linear systems and their control, control law partitioning, trajectory-following control, modelling and control of a single joint, present industrial robot control systems and introduction to force control
Machine Vision System: - Vision System Devices, Image acquisition, Masking, Sampling and quantisation, Image Processing Techniques, Noise reduction methods, Edge detection, Segmentation

UNIT 4: (~9 Lecture Hours)

Robot Programming: Methods of robot programming, lead through programming, motion interpolation, branching capabilities, WAIT, SIGNAL and DELAY commands, subroutines,
Programming Languages: Introduction to various types such as RAIL and VAL II …etc., Features of each type and development of languages for recent robot systems

UNIT 5: (~8 Lecture Hours)

Associated Topics in Robotics: - Socio-Economic aspect of robotisation, Economical aspects for robot design, Safety for robot and associated mass, New Trends & recent updates in robotics, International Scenario for implementing robots in Industrial and other sectors. Future scope for robotisation.

Text Books:

1. John J. Craig, Introduction to Robotics (Mechanics and Control), 2nd Edition, Addison-Wesley, 2004.
2. Mikell P. Groover et. al., Industrial Robotics: Technology, Programming and Applications, McGraw – Hill International, 1986.

3. Richard D. Klafter, Thomas A. Chemielewski, Michael Negin, Robotic Engineering: An Integrated Approach, Prentice Hall India, 2002.

Reference Books:

1. K.S. Fu, R.C. Gonzales, C.S.G. Lee, Robotics: Control, Sensing, Vision and Intelligence, McGraw Hill, 1987.
2. Shimon Y. Nof, Handbook of Industrial Robotics, John Wiley Co, 2001.

Course Outcomes:

After completion of the course, students will be able to

1. Identify a Robot for a specific application.
2. Identify parameters required to be controlled in a Robot.
3. To select suitable sensors and drive system for an application
4. To learn various robot programming methods and languages
5. To learn various industrial robot control systems and Mission Vision system
6. To understand Socio-Economic aspect of robotisation.

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IV Year B.Tech. II-Semester				
Course Code: OE	**3**	**-**	**-**	**3**

DEPARTMENT OF HUMANITIES & MATHEMATICS

MARKETING MANAGEMENT

(Open Elective- 4)

Prerequisites: -Nil-

Course Objectives:

1. To orient the importance of Marketing in Product delivery.
2. To understand buyer behavior in Product selection.
3. To give overview of Marketing Mix in Product delivery.

UNIT 1: (~08 Lecture Hours)

Introduction to Marketing Management

Marketing Management - Meaning and importance – Nature & Scope – Core concepts including Marketing Mix and Marketing Research – Evolution of Marketing concepts from Production concept to Societal Marketing concept – Green Marketing – Marketing Process.

UNIT 2: (~10 Lecture Hours)

Market Segmentation & Buyer Behavior

Market Segmentation: - Levels & Patterns of Market Segmentation – Segmentation of Consumer & Business Markets –Target Marketing – Developing and Communicating a positioning strategy – Differential Tools - New Product Development and its process.

Buyer Behavior – Importance of Buyer behavior -Factors influencing buyer behavior – Cultural – Social – Personal & Psychological – Buying decision process - stages of buying decision process.

UNIT 3: (~10 Lecture Hours)

Product Offerings and Pricing Strategies

Product Offering: The Product and Product Mix – Product Line decisions – Brand Decisions – Packaging and Labeling.

Pricing Strategies: - Setting the Price - Adapting the Price – Initiating and Responding the Price changes.

UNIT 4: (~09 Lecture Hours)

Managing Marketing Channels through Networks

Distribution:- Distribution Channels and Value Network – Channel Intermediaries – Channel Structure – Decision and Functions – Channel Dynamics – Retailing – Types – Wholesaling – Market Logistics.

UNIT 5: (~09 Lecture Hours)

Promotion

Promotion:- Nature and Importance of Promotions – Designing and Managing Promotion Mix – Managing Advertising – Sales Promotion - Personal Selling – Public Relation – Direct Marketing – Publicity and Social Media – Managing Digital Communication – E-Marketing , M-Marketing, Services Marketing.

Text Books:

1. Philip Kotler, Marketing Management, Prentice – Hall of India Pvt Ltd, 11th Edition, 2003.
2. Philip Kotler and Kevin Lane Keller, Marketing Management, Pearson, 15th Edition, 2016.

Reference Books:

1. Rajagopal, Marketing – Concept and Cases, New Age International (P) Ltd., 2008.
2. NVS Raju, Industrial Engineering & Management, Cengage Learning, 2013.
3. Richard J. Semenik, Promotion & Integrated Marketing Communication, Thomson South-Western, 2006.

Online Resources:

Marketing Management:

1. https://nptel.ac.in/courses/110104068/
2. https://nptel.ac.in/courses/110104070/

Course Outcomes:

After completion of the course, student will be able to

1. Understand the importance of the Marketing Management Process
2. Conduct Marketing Research, comprehend buyer behavior and hypothesize market segmentation.
3. Identify the elements of product mix and pricing strategies.
4. Enumerate strategies of pricing in fixation.
5. Select appropriate network of product distribution.
6. Adapt to befitting promotional strategy.

IV Year B.Tech. II-Semester **L T P C**
Course Code: OE **3 - - 3**

DEPARTMENT OF BASIC SCIENCES

ENVIRONMENTAL IMPACT ASSESSMENT
(Open Elective-4)

Prerequisites: -Nil-

Course Objectives:
1. To provide knowledge on various aspects of Environment Impact Assessment Methodologies.
2. To understand the impact of development activities on water, air and biological Environment.
3. To prepare the Environmental Impact Statement (EIS) and Environmental Audit (EA) Report.
4. To provide knowledge about Environmental Legislations and ISO 14000 standards pertaining to Environmental Management.

UNIT 1: (~ 9 Lecture Hours)
Basic Concepts of EIA: Definition of Environmental Impact Assessment (EIA) and Environmental Impact Statement (EIS)**,** Initial environmental examination, Elements of EIA, Stages in EIA, factors affecting EIA, Classification of environmental parameters, Impact analysis. Preparation of Environmental Base map.
EIA Methodologies: Introduction, Criteria for the selection of EIA Methodology, EIA methods- Adhoc method, Matrix method, Network method, Environmental Media Quality Index method and Overlay methods. Cost Benefit Analysis.

UNIT 2: (~ 9 Lecture Hours)
Assessment of Impact of Development Activities: Deforestation – causes, effects and control measures, impact on Vegetation and Wildlife. Review of Environmental Impact Assessment, guidelines for preparation of Environmental Impact Statement. Environmental Impact Mitigation measures.

UNIT 3: (~ 8 Lecture Hours)
Procurement of Relevant Soil Quality: Soil – types and quality, impact prediction of soil quality due to human developmental activities, impact assessment and its significance. Identification and incorporation of mitigation measures.

UNIT 4: (~ 9 Lecture Hours)
Environmental Audit: Objectives of Environmental Audit, types of Environmental Audit, Audit protocol. Stages of Environmental Audit - onsite activities, evaluation of audit data and preparation of Audit report, Post Audit activities.

UNIT 5: (~ 9 Lecture Hours)
Environmental Legislations: Objectives of Environmental Legislations, The Environmental (Protection) Act 1986, The Water (Prevention and Control of Pollution) Act 1974, The Air (Prevention and Control of Pollution) Act 1981, The Motor Act 1988, The Wild life (Protection) Act 1972. Concept of ISO and ISO 14000, Case studies and preparation of Environmental Impact Statement for various Industries.

Text Books:

1. Larry Canter, Environmental Impact Assessment, Mc Graw-Hill Publications, 1996.
2. R. R Barthwal, Environmental Impact Assessment, New Age International Publications, 2010.
3. Environmental Impact Assessment: Theory & Practice, P. Wathern Publishers Rutledge, London, 1992

Reference Books:

1. R.K. Khitoliya, Environmental Pollution, S. Chand Publishing, 2014.
2. J. Glynn and W. H. Gary, Environmental Science and Engineering, Prentice Hall Publishers, 1996.
3. Suresh K. Dhameja, Environmental Science and Engineering, S.K. Kataria and Sons Publication, New Delhi.2006.
4. H. S. Bhatia, Environmental Pollution and Control, Galgotia Publication Private Limited, Delhi. 2003.
5. M.Anji Reddy, Environmental Impact Assessment, BSP Books Private Limited, 2017.

Online Resources:

1. Environmental Impact Assessment – Open Educational Resource http://www.raymondsumouniversity.com/eia-local/about.html
2. Environmental Impact Assessment - https://unep.ch/etb/publications/enviImpAsse.php
3. Urban Environmental Management - http://www.gdrc.org/uem/eia/impactassess.html
4. Environmental Impact Assessment Report https://www.miga.org/sites/default/files/archive/Documents/EIA_Rwanda_Stones.pdf
5. https://cept.ac.in/cce/admin/images/files/1347949702_po7tf.pdf
6. https://www.iisd.org/learning/eia/
7. https://www.iaia.org/iaia-training-courses.php
8. https://www.eiatraining.com/index.html

Course Outcomes:

After completion of the course, students will be able to

1. Understand the basic concepts of Environmental Impact Assessment, Environmental Impact Statement and Environmental Audit.
2. Identify the environmental aspects to be considered for the Environmental Impact Assessment study.
3. Apply the knowledge of Environmental Impact Assessment studies in Preparation of Environmental Impact Statement.
4. Prepare suitable methodology in Environmental Impact Assessment documentation.
5. Analyse and evaluate the mitigation measures of developmental activities on environmental components.