

G. NARAYANAMMA INSTITUTE OF TECHNOLOGY & SCIENCE
(For Women)

(AUTONOMOUS)
Shaikpet, Hyderabad– 500104

ACADEMIC REGULATIONS 2018

for CBCS Based M.Tech. Degree Course (Regular/Full Time PG Programme)

(Effective for the students admitted into I year from the Academic Year **2018-19** and onwards)

- 1.0 Post-Graduate Degree Course (PGDC) 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 2 Year (4 Semesters) Master of Technology (M. Tech.) Degree Course under Choice Based Credit System (CBCS), with effect from the Academic Year 2018 - 19 onwards in the following Branches of Engineering & Technology with the Specializations as listed below :

<i>S.No.</i>	<i>Branch/ Department</i>	<i>Specialization</i>
I.	Computer Science & Engineering	Computer Science & Engineering
II.	Electrical & Electronics Engineering	Power Electronics & Electric Drives
III.	Electronics & Communication Engineering	Digital Electronics & Communication Engineering
IV.	Electronics & Telematics Engineering	Wireless & Mobile Communications
V.	Information Technology	Computer Networks & Information Security

2.0 Eligibility for Admission

- 2.1** Admission to the **PGDC** shall be made either on the basis of - the Rank/Percentile earned by the candidate in the relevant qualifying GATE Examination, OR the Merit Rank obtained by the qualifying candidate at an Entrance Test conducted by the Telangana State Government (PGECET) for M.Tech. Programmes, OR an Entrance Test conducted by the Jawaharlal Nehru Technological University Hyderabad, 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 all the PG Programmes shall be ENGLISH only.

3.0 M.Tech. Degree Course Structure

- 3.1** All M.Tech. Programmes at GNITS are of the Semester Pattern with 4 Semesters constituting 2 Academic Years, and each Academic Year has 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 the various terms and abbreviations used in this PGDC - Academic Regulations/Norms.

3.2.1 Semester Scheme:

Each M.Tech Degree Course is of 2 Academic Years (4 Semesters) with each academic year divided into two Semesters of ~ 22 weeks (≥ 90 working days) each, and 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 and suggested by UGC and AICTE are taken as ‘references’ for the present set of Regulations. The terms ‘SUBJECT’ or ‘COURSE’ imply the same meaning here, and refer to ‘Theory Subject’, or ‘Lab/Practical Course’, or ‘Design/ Drawing Subject’, or ‘Elective (Program Specific Elective/ Open Elective)’, or ‘Mini-Project with Seminar’, or ‘Project’, or ‘Audit Course’ 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** (Lecture Periods: Tutorial Periods: Practicals Periods : Credits) 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 Audit Courses shall not carry Credits.

3.2.3 Subject/ Course Classification :

All Subjects/ Courses offered for the PGDC are broadly classified as:

(a) Core Courses (CoC), and

(b) Elective Courses (Elc)

- 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 (Program Specific Elective) Courses
 - (iii) OE (Open Elective) Courses; and
 - (iv) Project Works (PW);
- Specific prescribed Course by AICTE Model Curriculum (on “Research Methodology & IPR”).
- Audit Courses (as listed by AICTE Model Curriculum).

3.2.4 Course Nomenclature :

The Curriculum Nomenclature and Course Structure grouping for GNITS M.Tech. Degree Programmes are as listed below:

S. No.	Broad Course Classification	Course Group/ Category	Courses Description	Credits
1)	Core Courses (CoC)	PC - Professional Core	Includes Core subjects related to the Parent Department/ Branch of Engg.	20
2)	Elective Courses (ElC)	PE – Program Specific Elective	Includes Elective subjects related to the Parent Department/ Branch of Engg.	15
3)		OE - Open Elective	Elective Courses which include subjects from other technical and/or Emerging Areas	3
4)	Project Related Courses	PW - Project Work	M.Tech. Project or PG Project or PG Major Project (Phase-I and Phase-II)	26
		Mini-Project with Seminar (MPS)	Seminar based on core contents related to the Parent Department/ Branch of Engg. in identified specialization	2
5)	Prescribed Course	AICTE Model Curriculum 2018	Research Methodology & IPR	2
6)	Audit Courses	AICTE Model Curriculum 2018	Inclusive of AICTE Suggested List	No Credits
Total Credits for PGDC				68

4.0 Course Work

4.1 A student after securing admission, shall pursue and complete the M.Tech. Degree Course in a minimum period of 2 Academic Years (4 Semesters), and/or within a maximum period of 4 Academic Years (starting from the Date of Commencement of I Year).

4.2 Each student shall register for and secure the specified number of Credits required for the completion of the PG Degree Course and Award of the M.Tech. Degree in the respective Branch of Engineering with the chosen Specialization.

4.3 The I Year is structured to provide typically 18 Credits in each of the I and II Semesters, and II Year comprises of 16 Credits in each of the I and II semesters, totalling to 68 Credits for the entire M.Tech. Programme.

5.0 Course Registration

5.1 A 'Faculty Advisor' shall be assigned to each M.Tech. Degree Course student with respective Specialization, and the Faculty Advisor assigned shall advise/counsel

the student about the M.Tech. Programme Specialization, 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** 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 being retained with the Head, Faculty Advisor and the Student).
- 5.4** A student shall Register for Subjects/Courses of ‘her CHOICE’ with a total of 18 Credits per semester in the I Year as structured in the Course Curriculum, which will be treated as the Minimum Work Load; she may also seek registration for a maximum of 3 additional/extra credits from those specified for the II Year I Semester (Maximum Work Load thus limited to 21 C) based on her interest, competence, progress, and ‘pre-requisites’ as indicated for various Subjects/ Courses in the Department Course Structure (for the relevant Specialization) and the Syllabus contents for various Subjects/ Courses, as applicable. All the remaining Credits shall be registered in the II Year-I and II Semesters.
- 5.5** The choice for the ‘Additional Subjects/ Courses’ in the I Year (in any semester, above the typical 18 Credit norm, and within the Maximum Permissible Limit of 21 Credits, as applicable) must be indicated clearly in the ONLINE Registration, which needs the specific approval and the signature of the Faculty Advisor/Counsellor assigned and the Head of the Department on the hard-copy.
- 5.6** 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 for that particular PGDC Specialization, ONLY the first mentioned Subject/Course in that Category will be taken into consideration, as applicable.
- 5.7** The Subject/Course Options exercised through ONLINE Registration are final and CANNOT be changed, and CANNOT be inter-changed; further, alternate choices shall also not be considered. However, if the Subject/Course that has already been listed for Registration (by the Head of Department) in a semester could not be offered due to any unforeseen or unexpected reasons, then the student may 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.

- 5.8** The Dropping of Subjects/ Courses in any semester of the I Year may be permitted, ONLY AFTER obtaining prior approval and signature from the Faculty Advisor (subject to retaining the minimum of specified 18 Credits) 'within 15 Days of Time' from the beginning of the current semester.

6.0 Class Strength

- 6.1** The typical student strength for each semester shall be 18 (or as per JNTUH / AICTE Approved Intake).

- 6.2** A Subject/Course may be offered to the students, ONLY IF a minimum of 50% of the students of a PG Specialization opt for the same.

- 6.3** In case of the options for Subjects/Courses coming from students of other Departments/Branches/Disciplines also, PRIORITY shall be given to the student of the 'Parent Department' first.

7.0 Attendance Requirements

- 7.1** A student shall be eligible to appear for the Semester End Examination (SEE) of any subject, if she acquires a minimum of 75% of attendance in that Subject for that semester.

- 7.2** The condoning of shortage of attendance up to 10% in each Subject (for 65% and above, and below 75% attendance cases) of a semester may be granted by the College Academic Committee (CAC) on genuine and valid grounds based on the student's representation with supporting evidence.

- 7.3** A stipulated fee per Subject/Course shall be payable towards condoning of shortage of attendance.

- 7.4** The Shortage of Attendance below 65% in any Subject shall in NO case be condoned.

- 7.5** A student, whose shortage of attendance is not condoned in any Subject(s) in any semester, is considered as 'Detained Student in that Subject(s)', and is not eligible to take End Examination(s) in the Subject(s) detained in that semester; and she has to seek Re-registration for those Subject(s) in subsequent semesters, and attend the same as and when offered.

- 7.6** Every student shall put in the minimum required attendance (as specified in Clauses 7.1-7.3) in at least 3 theory subjects and 2 lab courses – (i) in I Year I Semester, for promotion to I Year II Semester, and similarly - (ii) in I Year II Semester along with the 'Mini-Project with Seminar', for promotion to II Year I Semester.

- 7.7** A student shall not be promoted to the next semester unless she satisfies the attendance requirements of the present semester, as applicable. In such cases, she may seek readmission into that semester (and register for all semester

subjects), as and when offered. When she fulfils the attendance requirements in the present semester, she shall not be eligible for readmission (or re-register) into the same class/semester again.

8.0 Academic Requirements

The following Academic Requirements have to be satisfied, in addition to the Attendance Requirements mentioned in 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 40% marks (28 out of 70 marks) in the Semester End Examination (SEE), and a minimum of 50% of marks (50 out of 100 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.
- 8.2** A student shall be deemed to have satisfied the Academic Requirements and earned the Credits allotted to - Mini-Project with Seminar (MPS), in I year II semester if she secures not less than 50% of the total marks allocated. The student would be treated as failed, if she - (i) does not execute the Mini-Project (and prepare the report) as specified by the Supervisor, or (ii) does not present the Seminar as required, or (iii) secures less than 50% of Marks (< 50 marks) in evaluation. She may have to reappear for the 'Mini-Project with Seminar' evaluation, when it is re-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(s), as and when scheduled, as supplementary candidate.
- 8.3** A student shall register for all Subjects covering 68 Credits as specified and listed in the Course Structure for the chosen M.Tech. Degree Specialization, put up all the Attendance and Academic requirements for securing 68 Credits obtaining a minimum of C Grade or above in each Subject, and 'earn all 68 Credits securing SGPA ≥ 5.0 (in each semester) and final CGPA (i.e., CGPA at the end of PGDC is to be ≥ 5.0), to successfully complete the PGDC.
- 8.4** The Marks and the Letter Grades obtained in all those Subjects covering the specified 68 Credits alone shall be considered for the calculation of final CGPA, which shall be indicated in the Grade Card of the II Year II Semester.
- 8.5** If a student registers for few more 'extra Subjects' (in the parent Department or other Departments/Branches of Engg.) other than those listed Subjects totalling to 68 Credits as specified in the Course Structure, the performances in those 'extra Subjects' (although evaluated and graded using the same procedure as that of the required 68 Credits) shall not be taken into account while calculating the SGPA and CGPA. For such 'extra 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 in Clauses 7.0 and 8.1 – 8.4 above.
- 8.6** A student who fails to earn 68 Credits as per the specified Course Structure, and as indicated in Clauses 8.1- 8.5, within 4 Academic Years from the Date of

Commencement of her I Year, shall forfeit her seat in M.Tech. Programme and her admission shall stand cancelled.

- 8.7** When a student is detained due to the shortage of attendance in any Subject(s) in any semester, no Grade Allotment shall be done for such Subject(s), and SGPA/ CGPA calculations of that semester shall not include the performance evaluations of such Subject(s) in which she gets detained. However, she becomes eligible for re-registration of such Subject(s) (in which she gets detained) in the subsequent semester(s), as and when offered next, with the Academic Regulations of the Batch into which she gets readmitted, by paying the stipulated fees per Subject to the College. In all these re-registration cases, the student shall have to secure a fresh set of Internal Marks (CIE) and Semester End Examination Marks (SEE) for performance evaluation in such Subject(s), and subsequent SGPA/ CGPA calculations.

- 8.8** A student eligible to appear for the Semester End Examination (SEE) in any Subject, but is absent at it or failed (failing to secure C Grade or above), may reappear for that Subject at the supplementary examination (Supplementary SEE) as and when conducted. In such cases, her Internal Marks (CIE) assessed earlier for that Subject/ Course shall be retained and added to the marks to be obtained in the supplementary examination (Supplementary SEE) for the evaluation of her performance in that Subject.

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 the Theory or Practicals or Mini-Project with Seminar or Drawing/Design etc; further, Phase-I and Phase-II of the M.Tech. Project Work (in II Year I and II semesters) shall also be evaluated for 100 marks each. These evaluations shall be based on 30% CIE and 70% SEE, and a Letter Grade corresponding to the % of marks obtained shall be given.

- 9.2** For all the Subjects/ Courses as mentioned in 9.1, the distribution shall be: 30 marks for CIE (Continuous Internal Evaluation), and 70 marks for the SEE (Semester End Examination).

- 9.3 a)** For the Theory Subjects, the CIE marks shall comprise of - Mid-Term Examination marks (for 30 Marks).

b) During the semester, there shall be 2 Mid-Term examinations. Each Mid-Term examination shall be for 30 marks (with 120 minutes duration), and the question paper shall contain 2 parts, Part-A is for 06 Marks and shall contain 3 short answer questions of 02 marks each and Part-B is for 24 Marks and shall contain 5 questions of 8 Marks each out of which 3 questions are to be answered. The first Mid-Term examination shall be conducted at 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, immediately after the completion of the class work, for the remaining 50% of the syllabus; each shall be evaluated for 30 marks.

c) The first mid-term examination marks, shall make the first set of CIE marks, and the second mid-term examination marks shall make the second set of CIE

marks; and the AVERAGE of the two sets of mid-term 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, there shall be a Continuous Internal Evaluation (CIE) during the semester for 30 marks, and Semester End Examination (SEE) at the end of the semester for 70 marks. Out of the 30 marks for Internals, day-to-day work assessment in the laboratory shall be evaluated for 20 marks; and the performance in an internal Lab./Practical Test shall be evaluated for 10 marks. The Semester End Examination (SEE) for Lab./ Practicals shall be conducted at the end of the semester by the Lab. Teacher concerned and another faculty member of the same Department as assigned by the Head of the Department.

9.5 a) There shall be a Mini-Project, preferably in collaboration with an Industry with the relevant specialization to be registered and executed during the I Year II Semester, for about sixteen weeks duration. It shall also carry 100 marks, out of which CIE shall be for 30 marks, and SEE shall be for 70 marks. Marks earned under CIE for the 'Mini-Project with Seminar' shall be awarded by the Mini-Project Guide/Supervisor (based on the continuous evaluation of student's performance during the Mini-Project execution period).

b) The Mini-Project work shall be submitted in a Technical Report form, and a presentation of the same shall be made before a Committee as a Seminar, and the 'Mini-Project with Seminar' shall be evaluated by the committee for 70 Marks (SEE). The Committee shall consist of the Head of the Department, the Supervisor of Mini-Project, and a Senior Faculty Member of the Department. Performance evaluation of the 'Mini-Project with Seminar' shall be included in the I Year II Semester Grade Card.

9.6 **Electives:** 5 Program Specific Elective Courses and 1 Open Elective Course are offered in the 4 Semester PG Degree Course at GNITS, as per AICTE Model Curriculum. Students are to choose each Elective Course from the corresponding Set of Electives given, and the evaluation of the Elective Course shall be the same as that for the Theory Course/Subject.

9.7 Every student shall be required to execute her M.Tech. Project under the guidance of the Supervisor assigned to her by the Head of the Department, and shall submit her dissertation on a topic relevant to her PG specialization.

a) The M.Tech. Project shall start immediately after the completion of the I Year II Semester, and shall be divided and carried out in 2 phases : Phase-I during II Year I Semester, and Phase-II during II Year II Semester. The student shall prepare and submit two independent Project Work Reports - Project Work Report-I shall include the Project Work carried out under Phase-I, and the Project Work Report-II (Final Report) shall include the Project Work carried out under Phase-I and Phase-II put together.

b) In Phase-I of the Project Work, the student shall carry out the literature survey, select an appropriate topic and submit a Project Proposal within 6 weeks (immediately after her I Year II Semester End Examinations), for

approval by the Project Review Committee (PRC). The PRC shall be constituted by the Head of the Department, and shall consist of the Head of the Department, Project Supervisor, and a Senior Faculty Member of the Department. The student shall present her Project Work Proposal to the PRC (PRC-I Presentation), on whose approval she can 'REGISTER for the M.Tech Project'. Every student shall compulsorily register for her M.Tech. Project Work, preferably within the 6 weeks of time-frame as specified.

c) After the Registration, the student shall carry out the work, and periodically submit 'a periodic progress report' to her Supervisor throughout the Project period. The PRC shall monitor the progress of the Project Work and review, based on the PRC-II and PRC-III presentations and performance evaluations – the first one at the middle of the II Year I Semester, and the second one at the end of the II Year I Semester (before the I Semester End Examinations). The student shall also submit the Project Work Report-I to the PRC at PRC-III, for the PRC-III considerations and evaluations.

d) 100 marks are allocated for each Phase (Phase-I and Phase-II) of the Project Work, out of which 30 marks shall be for CIE (Continuous Internal Evaluation/CIE), and 70 Marks will be for SEE (Semester End viva-voce Examination).

e) The marks earned under CIE for the Phase-I of the Project shall be awarded by the Project Guide/Supervisor (based on the continuous evaluation of student's performance, all her PRC presentations during the Project Work Phase-I period and Project Work Report-I). For SEE marks of Project Phase-I, the Project Work Report-I shall be examined, and viva-voce shall be conducted at the end of the II Year I Semester (along with PRC-III) by the PRC, and the corresponding SEE marks shall be awarded.

f) The Phase-II of the Project shall be carried out in the II Year II Semester, and the student's progress and performance evaluation shall be carried out through PRC-IV (at the middle of the II semester), and PRC-V (at the end of the II semester) presentations. The student shall submit the Project Work Report-II (Final Project Report or Dissertation Draft Copy) to the PRC at PRC-V, for the PRC-V considerations and evaluations. Marks earned under CIE for Phase-II of the Project shall be awarded by the Project Guide/Supervisor (based on the continuous evaluation of student's performance, all her PRC presentations during the Project Work Phase-II period and Project Work Report-II). Marks earned under SEE for Phase-II Work shall be awarded by the External Examiner, after the evaluation of the M.Tech. dissertation and the final viva-voce examination of the M.Tech. Project work.

g) After the PRC-V presentation, the PRC shall evaluate the entire performance of the student and declare the Project Work as 'Satisfactory' or 'Unsatisfactory'. Every Final Project Work Report (that has been declared 'satisfactory') shall undergo 'Plagiarism Check' as per the University/ College norms to ensure the content plagiarism below a specified level of 30%, and to be acceptable for submission. In case of the unacceptable plagiarism levels, the student shall resubmit the Modified Project Work Report/Dissertation after

carrying out the necessary modifications/additions to her Project Work/Report as suggested by the PRC within the specified time.

h) If any student could not be present for any PRC at the scheduled time (after approval and registration of her Project Work at the PRC-I), or her progress is considered as 'not satisfactory' at any scheduled PRC, she will have to reappear (within one month period) for the same PRC presentation and evaluation at a later date/time as suggested by the PRC.

i) A student is allowed to submit her M.Tech. Project Dissertation 'only after the completion of 40 weeks from the date of approval/registration' of her Project, and after obtaining all the approvals from the PRC. The Extension of time, within the total permissible limits of completion of the PGDC may be considered by the PRC on sufficient valid, genuine grounds.

j) The student shall be allowed to submit her M.Tech. Project Dissertation, only on the successful completion of all the prescribed PG Subjects (Theory and Labs.), Mini-Project with Seminar, etc. (securing C Grade or above), and after obtaining all approvals from PRC. In such cases, the M.Tech. dissertation will be sent to an External Examiner nominated by the Principal of the College, from the panel of 3 names of external faculty members (Professors or Associate Professors, outside the college) suggested by the Head of Department, on whose approval, the student can appear for the M.Tech. Project viva-voce Examination, which shall be conducted by a Board, consisting of the PG Project Supervisor, Head of the Department, and the External Examiner who adjudicated the M.Tech. Project Work and Dissertation. The Board shall jointly declare the Project Work Performance as 'satisfactory', or 'unsatisfactory'; and in successful cases, the External Examiner shall evaluate the Student's Project Work presentation and performance for 70 Marks (SEE).

k) If the adjudication report of the External Examiner is 'not favourable', then the student shall revise and resubmit her M.Tech Dissertation after one semester, or as per the time specified by the External Examiner and/ or the PRC. If the resubmitted report is again evaluated by the External Examiner as 'not favourable', then that Dissertation will be summarily rejected. Subsequent actions for such rejected dissertations may be considered, only on the specific recommendations of the External Examiner and/ or PRC.

l) In cases, where the Board declared the Project Work Performance as 'unsatisfactory', the student is deemed to have failed in the Project viva-voce Examination, and she may reappear for the viva-voce Examination as per the Board's recommendations. If she fails in the second viva-voce Examination also, she shall not be considered eligible for the Award of the Degree, unless she is asked to revise and resubmit her Project Work by the Board within a specified time period (within 4 years from the date of commencement of her I Year I Semester).

10.0 Re-Admission / Re-Registration

10.1 Re-Admission for Discontinued Students :

The student who has discontinued the M.Tech. Degree Programme on account of any reasons whatsoever, may be considered for 'Readmission' into the same Degree Programme (with same specialization) with the Academic Regulations of the Batch into which she get readmitted, with prior permission from the authorities concerned, subject to Clause 4.1.

10.2 Re-Registration for Detained Students :

When any student is detained in a Subject(s) on account of the shortage of attendance in any semester, she may be permitted to re-register for the same Subject(s) in the 'same category' (Core or Elective Group) or equivalent Subject(s) if the same Subject is not available, as suggested by the BoS Chair of that Department, as and when offered in the sub-subsequent semester(s), with the Academic Regulations of the Batch into which she seeks re-registration, with prior permission from the authorities concerned, subject to Clause 4.1.

11.0 Grading Procedure

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

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

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

<i>% of Marks Secured (Class Intervals)</i>	<i>Letter Grade (UGC Guidelines)</i>	<i>Grade Points (GP)</i>
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 55% (≥ 55% , < 60%)	B (above Average)	6
Below 55% but not less than 50% (≥ 50% , < 55%)	C (Average)	5
Below 50% (< 50%)	F (FAIL)	0

- 11.4** A student obtaining F Grade in any Subject shall be considered ‘failed’, and will be required to reappear as ‘Supplementary Candidate’ in the Semester End Examination (SEE), in the subsequent semesters, as and when offered. In such cases, her Internal marks (CIE marks) in those Subject(s) will remain same as those she obtained earlier.
- 11.5** In general, a student shall not be permitted to repeat any Subject(s) with the sole intention of ‘Grade Improvement’ or ‘SGPA/ CGPA Improvement’. However, she has to repeat all those Subject(s), in which she gets ‘detained due to lack of required attendance’ (as listed in Clauses 8.7 and 10.2), through Re-Registration at a later date.
- 11.6** A student earns Grade Points (GP) in each Subject on the basis of the Letter Grade obtained by her in that Subject. Then, the corresponding ‘Credit Points’ (CP) are computed by multiplying the Grade Points with Credits for that particular Subject/Project.

$$\text{Credit Points (CP)} = \text{Grade Points (GP)} \times \text{Credits}$$

- 11.7** The student passes the Subject/Project only when she gets $GP \geq 5$ (C Grade or above).
- 11.8** The Semester Grade Point Average (SGPA) is calculated by dividing the Sum of Credit Points (ΣCP) secured from ALL the Subjects/ Seminar/ Comprehensive Viva-voce/Project 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:

$$\text{SGPA} = \{ \sum_{i=1}^N C_i G_i \} / \{ \sum_{i=1}^N C_i \} \dots \text{For each semester,}$$

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, C_i is the no. of Credits allotted to the i th Subject, and G_i represents the Grade Points (GP) corresponding to the Letter Grade awarded for that i th Subject.

- 11.9** The Cumulative Grade Point Average (CGPA) is a measure of the overall cumulative performance of a student over all Semesters considered for registration. The CGPA is the ratio of the Total Credit Points secured by a student in ALL registered Courses in ALL 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 Second Semester onwards, at the end of each Semester, as per the formula:

$$\text{CGPA} = \{ \sum_{j=1}^M C_j G_j \} / \{ \sum_{j=1}^M C_j \} \dots \text{For all S Semesters registered (ie., upto and inclusive of S semesters, } S \geq 2 \text{),}$$

where ‘M’ is the TOTAL no. of Subjects (as specifically required and listed under the Course Structure of that PGDC Specialization) the student has ‘REGISTERED’ from the 1st Semester onwards up to 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 j th Subject, and G_j represents the Grade Points (GP) corresponding to the Letter Grade awarded for that j th Subject. After Registration and completion of the I Year I Semester however, the SGPA of that Semester itself may be taken as CGPA, as there are no cumulative effects.

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

11.11 For the calculations listed in Clauses 11.6 – 11.10, performance in the 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.

11.12 Passing Standards :

- a) 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 PGDC, 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 PGDC), for the Award of the Degree, as required.
- b) 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/Grade Sheet shall show the details of the Courses Registered (Course Code, Title, No. of Credits, Grade Earned), Credits earned, SGPA, and CGPA etc.

12.0 Declaration of Results

12.1 The Computation of SGPA and CGPA are done using the procedure listed in Clauses 11.6 – 11.11.

12.2 For the Final % of Marks equivalent to the computed CGPA, the following formula may be used

$$\% \text{ of Marks} = \text{CGPA} \times 10$$

13.0 Award of Degree

13.1 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 M.Tech. Programme (PGDC), and secures the required number of 68 Credits (with CGPA ≥ 5.0), within the 4 Academic Years from the Date of Commencement of the First Academic Year, shall be declared to have 'QUALIFIED' for the Award of the M.Tech. Degree in the chosen Branch of Engineering, with the Specialization considered at the time of Admission.

13.2 A student who qualifies for the Award of the M.Tech. Degree (in her chosen Branch/ Specialization) as listed in Clause 13.1, shall be placed in the following Class Divisions:

- 13.3** a) A student with CGPA (at the end of the PG Degree Course) ≥ 8.00 , and fulfilling the following conditions -
- (i) should have passed all the Subjects/Courses in 'FIRST APPEARANCE' within the first 2 Academic Years (or 4 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 first 4 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 the shortage of attendance or any other reason **shall be placed in 'FIRST CLASS with DISTINCTION'**.
- b) A student with CGPA ≥ 8.00 , but has not fulfilled the conditions under Clause 13.3 (a) shall be placed in 'FIRST CLASS'.
- 13.4** A student with CGPA (at the end of the PG Degree Course) ≥ 6.50 but < 8.00 , shall be placed in 'FIRST CLASS'.
- 13.5** A student with CGPA (at the end of the PG Degree Course) ≥ 5.00 but < 6.50 , shall be placed in 'SECOND CLASS'.
- 13.6** A student with CGPA (at the end of the PG Degree Course) < 5.00 will not be eligible for the Award of the Degree.
- 13.7** A student fulfilling the conditions listed under Clause 13.3 (a) alone, shall be the eligible candidate for the 'University Rank' and 'Gold Medal' considerations.

14.0 Withholding of Results

- 14.1** If a student has not paid fees to the University/ College at any stage, or has pending dues against her name on account of any reason whatsoever, or if any case of indiscipline is pending against her, the result of such student may be withheld, and she shall not be allowed to enter the next higher semester. The Award or issue of the Degree may also be withheld in such cases.

15.0 Transitory Regulations

- 15.1** 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 M.Tech. Degree Course after the PGDC period of 2 years, may be considered eligible for readmission - to the same PGDC with same set of Subjects/ Courses (or equivalent Subjects/ Courses as the case may be), and/or to the same Program Specific Electives (or from same set/category of Electives or equivalents as suggested), as and when they are offered (within the time-frame of 4 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.

16.0 Student Transfers

16.1 There shall be no Branch/ Specialization transfers after the completion of the Admission Process.

17.0 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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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. The hall ticket of the student is to be cancelled and sent to the university.
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 university 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.	

G. NARAYANAMMA INSTITUTE OF TECHNOLOGY & SCIENCE
(For Women)

(AUTONOMOUS)

Shaikpet, HYDERABAD - 500 104

**M.Tech. 2 Year (4 semesters) Regular Programme in
Computer Science and Engineering**

COURSE STRUCTURE

(Applicable for the Batch admitted from the Academic Year 2018-19 onwards)

I YEAR

I SEMESTER

S.No	Group	Subject	L	T	P	Credits
1.	Program Core 1	Advanced Data Structures	3	-	-	3
2.	Program Core 2	Mathematical Foundations of Computer Science	3	-	-	3
3.	Program Specific Elective 1	Machine Learning / Introduction to Intelligent Systems/ Advanced Data Mining	3	-	-	3
4.	Program Specific Elective 2	Data Science/ Distributed Systems / Advanced Wireless and Mobile Networks	3	-	-	3
5.	Laboratory 1	Advanced Data Structures Lab	-	-	4	2
6.	Laboratory 2	Based on Program Specific Electives-1	-	-	4	2
7.	PW	Research Methodology & IPR	2	-	-	2
8.	Audit 1	AUDIT COURSE 1	2	-	-	-
TOTAL			16		8	18

I YEAR

II SEMESTER

S.No	Group	Subject	L	T	P	Credits
1.	Program Core 3	Advanced Algorithms	3	-	-	3
2.	Program Core 4	Soft Computing	3	-	-	3
3.	Program Specific Elective 3	Data Preparation and Analysis / Computer Vision / Distributed Databases	3	-	-	3
4.	Program Specific Elective 4	Human Computer Interaction / Digital Forensics / Cluster and Grid Computing	3	-	-	3
5.	Laboratory 3	Advanced Algorithms Lab	-	-	4	2
6.	Laboratory 4	Based on Program Specific Electives-3	-	-	4	2
7.	PW	MINI PROJECT with Seminar	-	-	4	2
8.	Audit 2	AUDIT COURSE 2	2	-	-	-
TOTAL			14	-	12	18

II YEAR			I SEMESTER			
S.No	Group	Subject	L	T	P	Credits
1.	Program Specific Elective 5	Compiler for HPC / Optimization Techniques / Big Data Analytics	3	-	-	3
2.	Open Elective 1		3	-	-	3
3.	PW	PROJECT/ DISSERTATION PHASE – 1	-	-	20	10
TOTAL			6	-	20	16

II YEAR			II SEMESTER			
S.No	Group	Subject	L	T	P	Credits
1.	PW	PROJECT/ DISSERTATION PHASE – 2	-	-	32	16
TOTAL			-	-	32	16

AUDIT COURSES 1

- 1) English for Research Paper Writing
- 2) Disaster Management
- 3) Pedagogy Studies
- 4) Personality Development through Life Enlightenment Skills

AUDIT COURSES 2

- 1) SANSKRIT for Technical Knowledge
- 2) Value Education
- 3) Constitution of India
- 4) Stress Management by YOGA

OPEN ELECTIVES

- 1) Business Analytics
- 2) Industrial Safety
- 3) Operations Research
- 4) Cost Management of Engineering Projects
- 5) Composite Materials
- 6) Energy from Waste
- 7) Power from Renewable Energy Sources

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I Year M.Tech. CSE I-Semester

L	T	P	C
3	-	-	3

ADVANCED DATA STRUCTURES
(Common to CSE & CNIS)

Prerequisites: Data Structures.

Course Objectives:

1. Able to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.
2. Able to understand the necessary mathematical abstraction to solve problems.
3. Familiarize with advanced paradigms and data structure used to solve algorithmic problems.

UNIT 1: (~ 8 Lecture Hours)

Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries.

Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing, Recent trends in hashing.

UNIT 2: (~ 8 Lecture Hours)

Skip Lists: Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists.

UNIT 3: (~ 12 Lecture Hours)

Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees.

UNIT 4: (~ 9 Lecture Hours)

Text Processing: String Operations, Brute-Force Pattern Matching, The Boyer Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.

UNIT 5: (~ 8 Lecture Hours)

Computational Geometry: One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quadrees, k-D Trees.

Text Books:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in JAVA, 3rd Edition, Pearson, 2004.
2. M T Goodrich and Roberto Tamassia, Algorithm Design, John Wiley, 2002.

Reference Books:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 2nd Edition, Pearson, 2004.
2. Sartaj Sahni, Data structures, Algorithms and Applications in Java, 2nd Edition, Universities Press, 2005.

Online Resources:

1. <https://www.cise.ufl.edu/~sahni/cop3530/presentations.htm>
2. <https://www.cdn.geeksforgeeks.org/advanced-data-structures>
3. http://www.nptelvideos.com/java/java_video_Lecture_Hours_tutorials.php

Course Outcomes:

After completion of the course, students will be able to

1. Demonstrate various hashing techniques.
2. Analyse and construct Skip Lists.
3. Develop and analyse algorithms for red-black trees, B-trees and Splay trees.
4. Develop algorithms for text processing applications.
5. Identify suitable data structures and develop algorithms for computational geometry problems.
6. Implement advanced data structures using Java.

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I Year M.Tech. CSE I-Semester

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MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE

Prerequisites: Discrete Mathematics.

Course Objectives:

1. Enhance the students' ability to think logically and mathematically.
2. Gain knowledge in discrete and continuous probability.
3. Use Graph theory for solving real world problems.
4. Solve problems using counting techniques and combinatorics.

UNIT 1: (~ 10 Lecture Hours)

Fundamentals: Probability mass, Density, Cumulative Distribution functions, Parametric families of distributions, Expected value, Variance, Conditional Expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov Chains.

UNIT 2: (~ 10 Lecture Hours)

Statistical Inference: Introduction, Parameter Estimation – Random Samples, Methods of Moments, Maximum-Likelihood Estimation, Confidence Intervals, Estimating Parameters of a Markov Chain, Estimation with Dependent Samples, Hypothesis Testing - Tests on Population Mean, Hypotheses Concerning Two Means, Hypotheses concerning variances, Goodness-of-Fit Tests.

UNIT 3: (~ 8 Lecture Hours)

Graphs: Graphs and Graph Models, Special Types of Graphs, Applications of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest Path Problems, Planar Graphs, Graph Coloring, Applications of Graph Colorings, Spanning Trees.

UNIT 4: (~ 10 Lecture Hours)

Counting: Basics of Counting, The Pigeon hole Principle, Permutations and Combinations, Enumerating Combinations and Permutations with Repetitions, Enumerating Permutations with Constrained Repetitions, Binomial Coefficients.

Advanced Counting Techniques: Recurrence Relations, Solving Linear Recurrence Relations, Divide and Conquer Algorithms, Generating functions, Inclusion-Exclusion, Applications of Inclusion - Exclusion.

UNIT 5: (~ 7 Lecture Hours)

Computer Science and Engineering Applications: Applications related to: Data Mining, Distributed Systems, Computer Networks - Routing algorithms, Machine Learning - HMM Model.

Text Books:

1. Kishor S. Trivedi, Probability & Statistics with Reliability. Queuing, and Computer Science Applications, 2nd Edition, John Wiley and Sons Ltd.
2. Kenneth H. Rosen, Discrete Mathematics and its Applications with Combinatorics and Graph Theory, 7th Edition, McGraw Hill Education (India) Private Limited.
3. Joe L. Mott, Abraham Kandel, Theodore P. Baker, Discrete Mathematics for Computer Scientists & Mathematicians, 2nd Edition, Pearson Education.

Reference Books:

1. D.S. Malik and M. K. Sen, Discrete Mathematics, Theory and Applications, Revised Edition, Cengage Learning.
2. Thomas Koshy, Discrete Mathematics with Applications, Elsevier Academic Press, 2012.
3. Douglas B. West, Introduction to Graph Theory, 2nd Edition, PHI.

Online Resources:

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

Course Outcomes:

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

1. Understand the basic notions of discrete and continuous probability.
2. Apply selected probability distributions to solve problems.
3. Understand the methods of statistical inference, and the role that sampling distributions play in those methods.
4. Understand how graphs are used as models in variety of areas.
5. Apply various counting techniques in solving combinatorial problems.
6. Gain knowledge in various applications related to computer science.

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I Year M.Tech. CSE I-Semester

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3	-	-	3

MACHINE LEARNING

(Program Specific Elective - 1)

Prerequisites: -

Course Objectives:

1. Student will be able to formulate machine learning problems corresponding to different applications.
2. Design and analyse various machine learning algorithms and techniques with a modern outlook focusing on advances.
3. Able to explore supervised, unsupervised, rule based and reinforcement learning paradigms of machine learning.

UNIT 1: (~ 8 Lecture Hours)

Introduction: Well posed learning problems, Designing a learning system, Perspectives and issues in machine learning. Types of Learning: Supervised, unsupervised and reinforcement learning.

Concept Learning: Concept learning task, Concept Learning as search through a hypothesis space, Finding maximally specific hypotheses, Version spaces and the candidate elimination algorithm, remarks on them, Inductive Bias.

UNIT 2: (~ 10 Lecture Hours)

Decision Tree Learning: Decision Tree representation and learning algorithm, Appropriate problems for Decision Tree Learning, Hypothesis space search in Decision Tree learning, Inductive bias in Decision Tree learning: Occam's razor, Issues in Decision Tree learning, Learning with active queries.

Bayesian Learning: Bayes theorem and concept learning, Maximum Likelihood and least square error Hypothesis, Minimum Description Length Principle, Bayes optimal classifier, Gibbs Algorithm, Naïve Bayes Classifier, Bayesian Belief Networks, The EM algorithm.

UNIT 3: (~ 8 Lecture Hours)

Computational Learning Theory: PAC Hypothesis, Sample complexity for finite and infinite hypothesis spaces, Mistake bound model.

Instance-based Techniques: Lazy vs. eager generalization, K-Nearest Neighbour Learning, Locally Weighted Regression, Radial Basis Functions, Case Based Reasoning.

UNIT 4: (~ 12 Lecture Hours)

Evaluation of Learning Algorithms: Estimating Hypothesis accuracy, Basics of sampling theory, General approach for deriving confidence intervals, Difference in error of two hypothesis, Comparing learning algorithms.

Learning by Rules: Learning sets of rules: Sequential covering algorithms, Learning rule sets: Summary, Learning first order rules, FOIL.

Analytical Learning: Learning with perfect domain theories: Prolog-EBG, Remarks on Explanation Based Learning.

UNIT 5: (~ 10 Lecture Hours)

Combining Inductive and Analytical Learning: Inductive analytical approaches to learning, Using prior knowledge - Initialize the hypothesis, Alter search objective, Augment search operators.

Reinforcement Learning:

Introduction, The Learning Task, Q-Learning, Non deterministic rewards and actions, Temporal difference Learning, Generalizing from examples, Relationship to dynamic programming

Text Books:

1. Tom M. Mitchell, Machine Learning, Mc Graw Hill Education, 1997.

Reference Books:

1. Kevin Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
2. Trevor Hastie, Robert Tibshirani & Jerome Friedman, "The Elements of Statistical Learning", Springer Series in Statistics, Second Edition, 2001.
3. William W Hsieh, "Machine Learning Methods in the Environmental Sciences, Neural Networks and Kernels", Cambridge University Press.
4. Stephen Marsland, "Machine Learning - An Algorithmic Perspective ", CRC Press, 2009.

Online Resources:

1. <http://www.cs.cmu.edu/~tom/>
2. <http://www.holehouse.org/mlclass/>

Course Outcomes:

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

1. Identify machine learning problems corresponding to different applications.
2. Recognize the basic theory underlying machine learning.
3. Identify machine learning techniques appropriate to respective problems.

4. Compare range of machine learning algorithms along with their strengths and weaknesses.
5. Understand the underlying mathematics and logic behind various supervised and unsupervised paradigms.
6. Apply different learning algorithms to solve problems of moderate complexity.

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I Year M.Tech. CSE I-Semester

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3	-	-	3

INTRODUCTION TO INTELLIGENT SYSTEMS

(Program Specific Elective - 1)

Prerequisites: Probability and statistics.

Course Objectives:

1. AI emphasize on solving real world problems for which solutions are difficult to express using traditional algorithmic approach.
2. Learn different knowledge representation techniques.
3. Understand the different learning techniques of AI systems.
4. Developing systems to demonstrate intelligent behaviour dealing with uncertainty.

UNIT 1: (~ 10 Lecture Hours)

Introduction: AI Problems, The Underlying Assumption, AI Techniques, Learning in Neural Networks: Perceptrons, Back-propagation Networks, Generalization, Boltzmann Machines, Applications of Neural Networks and recurrent networks.

Search Techniques: Three simple search methods: breadth-first search, depth-first search, iterative deepening search. Heuristic search methods: best-first search, hill climbing search. Optimization and search such as stochastic annealing and genetic algorithm.

UNIT 2: (~ 10 Lecture Hours)

Knowledge Representation Issues: Representations and Mappings, Approaches to Knowledge Representation, Issues in Knowledge Representation, The Frame problem.

Using Predicate Logic: Representing Simple Facts in Logic, Representing Instance and Isa Relationships, Computable Functions and Predicates, Resolution, Fuzzy Logic and Fuzzy Sets.

UNIT 3: (~ 10 Lecture Hours)

Constraint Satisfaction Problems: Constraint Satisfaction Problems, Backtracking Search for CSPs, Local Search for Constraint Satisfaction Problems.

Adversarial Search: Games, Optimal Decision in Games, Alpha-Beta Pruning.

UNIT 4: (~ 10 Lecture Hours)

Uncertain Knowledge and Reasoning : Uncertainty, Basic Probability Notation, The Axioms of Probability, Inference using Full Join Distributions, Independence, Bayes Rule and Its Use.

Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Extract Inference in Bayesian Networks, Approximate Inference in Bayesian Networks, Extending Probability to First-Order Representations, Certainty factors and Dempster-Shafer Theory of Evidential reasoning.

UNIT 5: (~ 8 Lecture Hours)

Learning: Learning from Observations, Forms of Learning, Inductive Learning, Learning Decision Trees.

Knowledge in Learning: A Logical Formulation of Learning, Knowledge in Learning, Explanation-Based Learning, Learning using Relevance Information.

Statistical Learning Methods: Learning with Hidden Variables, Instance-Based Learning.

Reinforcement Learning: Introduction, Passive and Active Reinforcement Learning.

Text Books:

1. E.Rich and K. Knight, Artificial Intelligence, 2nd Edition, (TMH).
2. Stuart Russel and Peter Norvig, Artificial Intelligence – A Modern Approach, 2nd Edition, PHI/ Pearson Education.

Reference Books:

1. Luger G.F. and Stubblefield W.A. Artificial Intelligence: Structures and strategies for Complex Problem Solving. Addison Wesley, 6th Edition, 2008.
2. Saroj Kaushik. Artificial Intelligence. Cengage Learning, 2011.

Online Resources:

1. http://www.vssut.ac.in/lecture_notes/lecture1428643004.pdf
2. [http://www.cs.toronto.edu/~fbacchus/csc384/Lecture Hours/Lecture Hours.html](http://www.cs.toronto.edu/~fbacchus/csc384/Lecture%20Hours/Lecture%20Hours.html)

Course Outcomes:

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

1. Understand knowledge of the fundamental principles of intelligent systems.
2. Select a search algorithm for different applications.
3. Understand the knowledge based systems.
4. Possess the skill to analyze and compare variety of AI problem solving techniques.
5. Acquire knowledge in Uncertainty and Probabilistic reasoning approaches.
6. Apply different learning techniques to solve complex problems.

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I Year M.Tech. CSE I-Semester

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ADVANCED DATA MINING
(Program Specific Elective - 1)

Prerequisites: Database Management Systems.

Course Objectives:

1. Introduce the methods for mining frequent patterns, associations and correlations.
2. Describe the methods for data classification and prediction, and data-clustering approaches.
3. Understand the concepts of time series data, data streams and World Wide Web.
4. Ability to solve real world problems in business and scientific information using data mining.

UNIT 1: (~ 8 Lecture Hours)

Data Mining: Introduction, Data Mining task primitives.

Mining Frequent Patterns, Association and Correlations: Basic Concepts, Efficient and Scalable Frequent Itemset Mining Methods, Mining Various Kinds of Association Rules, Constraint-Based Association Mining.

UNIT 2: (~ 10 Lecture Hours)

Classification and prediction: Issues Regarding Classification and Prediction, Classification by Backpropagation, Support Vector Machines, Prediction, Accuracy and Error Measures, Evaluating the Accuracy of a Classifier or Predictor.

UNIT 3: (~ 10 Lecture Hours)

Cluster Analysis: Types of Data in Cluster Analysis, Partitioning methods, Density-Based Methods, Grid-Based Methods, and Clustering High-Dimensional Data.

Mining Time series Data: Trend analysis, Similarity search in Time-series analysis, Periodicity Analysis for time related sequence data.

UNIT 4: (~ 10 Lecture Hours)

Mining Data Streams: Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Classification of dynamic data streams, Mining Sequence Patterns in Transactional databases, Graph Mining, Social Network Analysis.

UNIT 5: (~ 8 Lecture Hours)

Mining the World Wide Web: Mining the web page layout structure, Mining Web Link Structure, Mining Multimedia data on the Web, Automatic Classification of Web Documents and Web Usage Mining.

Applications and Trends in Data Mining: Data Mining Applications, Trends in Data Mining.

Text Books:

1. Jiawei Han and M Kamber, Data Mining Concepts and Techniques, Second Edition, Elsevier Publication, 2011.
2. Vipin Kumar, Pang-Ning Tan and Michael Steinbach, Introduction to Data Mining, Addison Wesley, 2006.

Reference Books:

1. Arun K Pujari, Data Mining Techniques, 3rd Edition, Universities Press.
2. Pualraj Ponnaiah, Data Warehouse Fundamentals, Wiley Student Edition.
3. G Dong and J Pei, Sequence Data Mining, Springer, 2007.
4. Vikaram Pudi and P Radha Krishna, Data Mining, Oxford University Press.

Online Resources:

1. <https://docs.google.com/file/d/0B5Ju2x50v6l5X0p3WDEwNkNTVW8/edit>
2. <https://www.kdnuggets.com/websites/index.html>
3. <https://www.ngdata.com/data-mining-resources/>

Course Outcomes:

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

1. Understand the concepts of frequent patterns, association and correlations in data mining.
2. Perform classification and prediction techniques on large data sets.
3. Analyze various clustering techniques.
4. Comprehend the technique to extract patterns from time series data and its applications in real world.
5. Apply and analyze the knowledge of Graph mining and Web mining.
6. Solve real world problems in business and scientific information using data mining.

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DATA SCIENCE
(Program Specific Elective - 2)

Prerequisites: Database Management Systems.

Course Objectives:

1. Provide you with 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. Provide Python code to statistically analyse a dataset.
4. Critically evaluate data visualization based on their design and use for communicating stories from data.

UNIT 1: (~ 8 Lecture Hours)

Introduction: Big Data and Data Science Hype, History of past and current, A Data Science Profile, Meta-Definition, Statistical Thinking, Exploratory Data Analysis, The Data Science Process, Case Study: Real Direct.

UNIT 2: (~ 10 Lecture Hours)

Algorithms: Machine Learning Algorithms, Three Basic Algorithms, Exercise: Basic Machine, Learning Algorithms.

Spam Filters, Naive Bayes, and Wrangling: Learning by Example, Naive Bayes, Laplace Smoothing, Comparing Naive Bayes to KNN, Sample Code in bash, Scraping the Web: APIs and Other Tools.

UNIT 3: (~ 10 Lecture Hours)

Logistic Regression: Thought Experiments, Classifiers, M6D Logistic Regression Case Study, Media 6 Degrees Exercise.

Extracting Meaning from Data: William Cukierski, The Kaggle Model, Ethical Implications of a Robo-Grader, Feature Selection, Google's Hybrid Approach to Social Research.

UNIT 4: (~ 10 Lecture Hours)

Data Visualisation Techniques: Data Visualization History, Types of Visualization, Characteristics, Encoding schemes, Mapping variables to encodings, Visual encodings.

Data Leakage and Model Evaluation: Claudia's Data Scientist Profile, Data Mining Competitions, Characteristics of Good Modeler, Data Leakage, Avoid Leakage, Evaluating Models.

UNIT 5: (~ 8 Lecture Hours)

Applications of Data Science: Recent trends in various data collections, analysis techniques, Visualizing techniques, application development methods (implementation in Python).

Text Books:

1. Cathy O'Neil and Rachel Schutt, Doing Data Science, Straight Talk From The Frontline, O'Reilly.
2. Samir Madhavan, Mastering Python for Data Science, Packt Publishing, 2015.

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.

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 suitable algorithms for data science.
2. Compare various techniques and use appropriate methods for given data set.
3. Design suitable models to extract useful information for the given data.
4. Present the data using suitable visualization methods.
5. Handle data leakage problems in data.
6. Analyze various hypothesis for better understanding.

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DISTRIBUTED SYSTEMS
(Program Specific Elective - 2)

Prerequisites: Operating Systems, Database Management Systems.

Course Objectives:

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

UNIT 1: (~ 8 Lecture Hours)

Characterization of Distributed Systems - Introduction, Examples of Distributed systems, Resource sharing and the web, Challenges.

System models - Introduction, Architectural models, Fundamental models.

UNIT 2: (~ 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, Multicast communication, Consensus and related problems.

UNIT 3: (~ 10 Lecture Hours)

Inter Process Communication - Introduction, The API for the Internet Protocols, External data representation and marshalling, Client-Server communication, Group communication, Case Study: IPC in UNIX.

Distributed objects and Remote Invocation - Introduction, Communication between distributed objects, Remote Procedure Call, Events and notifications, Case study: Java RMI.

UNIT 4: (~ 10 Lecture Hours)

Distributed File Systems - Introduction, File Service architecture, Case study 1: SUN network file system, Case study 2: The Andrew file system.

Distributed Shared Memory - Introduction, Design and Implementation issues, Sequential Consistency and IVY case study, Release Consistency,

Munin Case Study, Other Consistency Models, Google case study.

UNIT 5: (~ 8 Lecture Hours)

Name Services - Introduction, Name Services and the Domain Name System, Directory Services, Case study of the Global Name Services.

Distributed Transactions - Introduction to Transactions, Flat and Nested Distributed Transactions, Atomic commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery.

Text Books:

1. George Coulouris, J Dollimore and Tim Kindberg, Distributed Systems, Concepts and Design, Pearson Education, 4th Edition, 2009.

Reference Books:

1. Andrew S. Tanenbaum and Maarten Van Steen, Distributed systems, Principles and Paradigms, 2nd Edition, PHI, 2006.
2. Sukumar Ghosh, Distributed Systems- An Algorithm Approach, Chapman and Hall/CRC, Taylor and Fransis Group, 2007.

Online Resources:

1. <https://www.smartworld.com/notes/distributed-systems-notes-pdf-ds>
2. <http://nptel.ac.in/courses/106106107>
3. <https://edutainmentzone.blogspot.com> , Home , DS , Education

Course Outcomes:

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

1. Understand the concepts of distributed system, various system models.
2. Apply virtual time, agreement and consensus protocols in distributed systems.
3. Analyse the establishment of Inter process communication between distributed systems.
4. Comprehend and design a new distributed system with the features that support distributed file system and distributed shared memory.
5. Apply and analyse the knowledge of distributed transactions.
6. Develop new distributed applications.

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ADVANCED WIRELESS AND MOBILE NETWORKS
(Program Specific Elective - 2)

Prerequisites: Computer Networks

Course Objectives:

1. Understand the wireless/mobile communications needs and challenges.
2. Familiarity with concepts of wireless networks, standards, technologies and their basic operations.
3. Design and analyse various medium access protocols.
4. Knowledge of operating system used in WSNs.

UNIT 1: (~ 9 Lecture Hours)

Wireless Transmission: Frequencies for radio transmission, Signals, Antennas, Signal Propagation, Spread Spectrum.

Medium Access Control: Motivation for a specialized MAC, SDMA, FDMA, TDMA, CDMA, Comparison of S/T/F/CDMA.

UNIT 2: (~ 10 Lecture Hours)

Telecommunications System: GSM-Mobile services – System architecture, Radio interface, Protocols, Localization and calling, Handover, Security and New data service, GPRS, DECT-System architecture, Protocol architecture.

Wireless LAN: Infrared Vs Radio transmission, Infrastructure and Ad-hoc Networks, IEEE 802.11-System architecture 208, Protocol architecture, Physical layer, Medium access control layer, MAC Management, 802.11b and 802.11a.

UNIT 3: (~ 10 Lecture Hours)

Mobile IP Protocol: Introduction, Mobility Requirements & Constraints in an IP Environment, Mobile IP Protocol overview, Route Optimization, Mobility support for IPv6, Connectivity with 3G Networks, Management of Information Bases.

Transport Over Wireless Network: Introduction, Overview of TCP, TCP over Wireless Networks, Approaches to improve Transport Layer Performance.

UNIT 4: (~ 8 Lecture Hours)

Wireless Sensor Network: Basics, MAC Layer, Routing and Other Communication issues, Sensor localization, Power Management, Special WSNs, WSN application.

OS in sensors: Tiny OS for WSN.

UNIT 5: (~ 8 Lecture Hours)

Security & Fraud Detection in Mobile & Wireless Networks: Introduction, Network Security Problems, Network Security management Plan, Intrusion Detection System, Securing Data Transfer in Digital Mobile Systems, Securing Wireless Ad-hoc Networks, Authentication of Mobile Users, Subscription & Fraud Detection in Mobile Phone Systems.

Wireless PANs: Bluetooth and Zigbee.

Text Books:

1. Schiller J., Mobile Communications, Addison Wesley, 2000.
2. Stojmenic Ivan, Handbook of Wireless Networks and Mobile Computing, John Wiley and Sons Inc., 2002.
3. Fei Hu and Xianojun Cao, Wireless Sensor Networks Principles & Practice.

Reference Books:

1. Stallings W, Wireless Communications and Networks, Pearson Education, 2005.
2. Raj Kamal, Mobile Computing, Oxford publisher, 2nd Edition, 2015.

Online Resources:

1. https://learningnetwork.cisco.com/commUNITY/certifications/wireless_ccna/wifund/study-material

Course Outcomes:

After completion of the course, students will be able to

1. Gain knowledge of various types of wireless networks, standards, operations and use cases.
2. Design WLAN, WPAN and Cellular based upon underlying propagation.
3. Demonstrate knowledge of protocols used in wireless networks.
4. Give an overview of underlying Operating System for Wireless Sensor Networks.
5. Design wireless networks exploring trade-offs between wireline and wireless links.
6. Understand the security issues in Mobile & Wireless networks.

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ADVANCED DATA STRUCTURES LAB
(Common to CSE & CNIS)

Prerequisites: Data Structures.

Course Objectives:

1. Write and execute programs in Java to solve problems using data structures such as arrays, linked lists, stacks, queues, trees, hash tables and search trees.
2. Learn to implement various text processing & computational geometry algorithms.

Week 1: Write Java programs to implement the following using an array.
a) Stack ADT b) Queue ADT

Week 2: Write Java programs to implement the following using a singly linked list.
a) Stack ADT b) Queue ADT

Week 3: Write a Java program to implement priority queue ADT

Week 4: Write a Java program to implement all the functions of a dictionary (ADT) using Hashing.
a) Linear Probing b) Quadratic Probing

Week 5: Write a Java program to perform the following operations.
a) construct a SKIPLIST.
b) Search.
c) Update Operation on Skip Lists.

Week 6: Write a Java program to perform the following operations.
a) Construct a binary search tree of elements.
b) Search for a key element in the above binary search tree.
c) Delete an element from the above binary search tree.

Week 7: Write a Java program to perform the following operations.
a) Insertion into a B-tree. b) Deletion from a B-tree.

Week 8: Write a Java program to perform the following operations.
a) Insertion into an AVL-tree. b) Deletion from an AVL-tree.

Week 9: a) Write a Java program that implements Brute-Force algorithm for pattern matching.

b) Write a Java program that implements Boyer Moore algorithm.

Week 10: Write a Java program that implements KMP algorithm for pattern matching.

Week 11: Write a Java program to implement following algorithms.

a) Huffman coding b) Longest Common Subsequence Problem

Week 12: Write a Java program to perform the following operations.

a) Constructing a Priority Search Tree

b) Searching a Priority Search Tree

Text Books:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in JAVA, 3rd Edition, Pearson, 2004.
2. M T Goodrich and Roberto Tamassia, Algorithm Design, John Wiley, 2002.

Reference Books:

1. S.Sahni, Data structures, Algorithms and Applications in Java, 2nd Edition, Universities Press, 2005.
2. A.Drozdek, Data Structures and Algorithms in java, 3rd Edition, Cengage Learning, 2008.
3. J.R.Hubbard, Data Structures with Java, 2nd Edition, Schaum's Outlines, TMH, 2007.

Online Resources:

1. <https://www.hackerrank.com>
2. www.spoj.com

Course Outcomes:

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

1. Develop the programs for various data structures for stacks, queues.
2. Develop the programs for various non-linear data structures for linked lists, binary search tree, AVL tree and B-tree.
3. Develop the programs for various advanced data structures for dictionaries etc.
4. Implement various text processing algorithms.
5. Implement computational geometry algorithm.
6. Choose the appropriate data structure for solving real world problems.

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MACHINE LEARNING LAB

Prerequisites: -

Course Objectives:

1. Formulate machine learning problems corresponding to different applications.
2. Design and analyse various machine learning algorithms and techniques using Python/R.

Implement the following programs:

Week 1: Implementation of basic features.

a) Vectors b) Arrays c) Data Frames

Week 2: Create two data frames as follows

Data Frame 1:

Roll No	Name	Phone Number	Elective 1

Data Frame 2:

Roll No	Name	Phone Number	Elective 2

A) Create the Data frame using two data frames

Roll No	Name	Phone Number	Elective 1	Elective 2

B) Reshape the data frames in terms of electives using recasting process

Week 3: Write program that reads two matrices from two different files and apply the required operation. Note: If the size of matrix is not suitable to apply operation, then resize the matrix.

Week 4: Read the data of marks obtained by set of students and analyze the results using different plots.

Week 5: Write a program that reads box dimensions and computes the surface area and volume of each and create data frame that holds box id, surface area and volume.

Week 6: Read employee details stored in different file formats and extract the following details.

- a) Display the details of employee who draws the max salary.
- b) Display the list of employees who work in one department specified.
- c) Display the list of employee who joined before 2017 and write names and date of joining to another CSV file.

Week 7: Write program to implement linear regression with one variable to predict profits for given population. The sample data contains two columns one with population and the other with the profits relating to different cities.

Week 8: Construct decision tree for the following data entered and display the tree model.

Rec	Age	Income	Student	Credit rating	Buys_computer
r1	<=30	High	No	Fair	No
r2	<=30	High	No	Excellent	No
r3	31...40	High	No	Fair	Yes
r4	>40	Medium	No	Fair	Yes
r5	>40	Low	Yes	Fair	Yes
r6	>40	Low	Yes	Excellent	No
r7	31...40	Low	Yes	Excellent	Yes
r8	<=30	Medium	No	Fair	No
r9	<=30	Low	Yes	Fair	Yes
r10	>40	Medium	Yes	Fair	Yes
r11	<=30	Medium	Yes	Excellent	Yes
r12	31...40	Medium	No	Excellent	Yes
r13	31...40	High	Yes	Fair	Yes
r14	>40	Medium	No	Excellent	No

Week 9: Write a program to implement linear regression with multivariable's. Given details of cars in terms of milage, cylinder displacement, horse power and weight, establish the relationship between "mpg", as a response variable with "disp", "hp" and "wt" as predictor variable.

Week 10: Write a program to evaluate model accuracy using Leave-One-Out Cross validation on the models build using various methods.

Week 11: Using Naive bayes classifier to classify the sample data and show the prediction for test sample.

Week 12: Using K-Nearest Neighbour classify the data sample and give prediction for the given test sample.

Text Books:

1. Tom M. Mitchell, Machine Learning. Mc Graw Hill Education, 1997.
2. Sebastian Raschka, Python Machine Learning, PACKT Publishing, 2015.

Reference Books:

1. Kevin Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
2. Trevor Hastie, Robert Tibshirani and Jerome Friedman, "The Elements of Statistical Learning", Springer Series in Statistics, 2nd Edition 2001.
3. William W Hsieh, "Machine Learning Methods in the Environmental Sciences, Neural Networks and Kernels", Cambridge University Press.
4. Stephen Marsland, "Machine Learning - An Algorithmic Perspective ", CRC Press, 2009.
5. Charles R Severance, "Python for Everybody: Exploring Data in Python 3", CreateSpace Independent Publishing, 2016.

Online Resources:

1. <http://www.cs.cmu.edu/~tom/>
2. <http://www.holehouse.org/mlclass/>

Course Outcomes:

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

1. Learn programming using basic features like frames, arrays and matrices.
2. Ability to apply different operations to manipulate the data.
3. Knowledge to handle different file formats and analyze the data.
4. Understand the logic and underlying mathematics behind basic machine learning algorithms.
5. Apply different learning algorithms to solve problems.
6. Compare basic machine learning algorithms.

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INTRODUCTION TO INTELLIGENT SYSTEMS LAB

Prerequisites: -

Course Objectives:

1. Design and analyse various computing algorithms and techniques using Python/Scilab.
2. Able to apply different learning algorithms to solve real time problems.
3. Recognize the underlying mathematics and logic behind various AI techniques.

List of Experiments

Implement the following programs using Python/Scilab language.

Implementation of basic programs

Week 1:

- a) Program to reverse a given number.
- b) Program to check whether a given year is a leap year or not.
- c) Program to form a new string made of the first 2 characters and last 2 characters from a given string.
- d) Program to count the number of vowels present in a string.
- e) Program that reads a text file and counts the number of times a certain letter appears in the text file.

Week 2: Write a program for implementing search methods

- a) Breath-First Search.
- b) Depth-First Search.

Week 3: Program for implementing Heuristic search algorithm.

Week 4: Write a program to convert a crisp set to fuzzy set.

Week 5: Implement the Constraint Satisfaction problem using backtracking.

Week 6: Write a program for implementation of Adversarial search.

Week 7: Implement the Multilayer Perceptron Neural Network.

Week 8: Write a program to implement Backpropagation algorithm of ANN.

Week 9: Program for implementing Recurrent Networks.

Week 10: Write a program to implement Bayesian and Bayes algorithm.

Week 11: Write a program which gives the fittest value of the target using Genetic algorithm.

Week 12: Implementation of any case study using AI techniques.

Text Books:

1. Prateek Joshi, Artificial Intelligence with Python: A Comprehensive Guide to Building Intelligent Apps for Python Beginners and Developers, Packt publishing, January 2017.

Reference Books:

1. Prateek Joshi, Artificial Intelligence with Python – Heuristic Search [Video], PACKT, 2017.
2. Nilsson, Artificial Intelligence: A New Synthesis Paperback Elsevier India, First edition, July 2003.

Online Resources:

1. <https://www.researchgate.net/file.PostFileLoader.html?id...assetKey..>
2. <http://artint.info/AIPython/aipython.pdf>

Course Outcomes:

After completion of course the student will be able to

1. Write programs in Python/Scilab language.
2. Design different Artificial Neural Network models for solving real time problems.
3. Implement and apply fuzzy logic and reasoning to solve various engineering problems.
4. Apply genetic algorithms for finding the fittest value of the target.
5. Recognize the underlying mathematics and logic behind various computing algorithms under AI system.
6. Apply variety of learning algorithms to solve problems of moderate complexity.

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ADVANCED DATA MINING LAB

(Program Specific Elective - 1)

Prerequisites: Database Management Systems.

Course Objectives:

1. Introduce the methods for mining frequent patterns, associations and correlations.
2. Describe the methods for data classification and prediction and data-clustering approaches.
3. Ability to solve real world problems in business and scientific information using data mining.

List of Experiments

Implement the following algorithms using Weka / Python / R.

Week 1: Familiarization of the tool used for advanced data mining lab.

Week 2: Demonstrate preprocessing techniques on the given dataset.

Week 3: Implement Association rule process on the given dataset using apriori algorithm.

Week 4: K-means algorithm for clustering.

Week 5: Implement Support vector machine algorithm on the given dataset.

Week 6: Implementation of back propagation algorithm.

Week 7: Write a program to implement linear regression with one variable to predict profits for given population. The sample data contains two columns one with population and the other with the profits relating to different cities.

Week 8: Apply Naive bayes classifier to classify the sample data and show the prediction for test sample.

Week 9: Construct decision tree for the following data entered and display the tree model.

Record	Age	Income	Student	Credit_rating	Buys_computer
r1	<=30	High	No	Fair	No
r2	<=30	High	No	Excellent	No
r3	31...40	High	No	Fair	Yes
r4	>40	Medium	No	Fair	Yes
r5	>40	Low	Yes	Fair	Yes
r6	>40	Low	Yes	Excellent	No
r7	31...40	Low	Yes	Excellent	Yes
r8	<=30	Medium	No	Fair	No
r9	<=30	Low	Yes	Fair	Yes
r10	>40	Medium	Yes	Fair	Yes
r11	<=30	Medium	Yes	Excellent	Yes
r12	31...40	Medium	No	Excellent	Yes
r13	31...40	High	Yes	Fair	Yes
r14	>40	Medium	No	Excellent	No

Week 10: Using K-Nearest neighbour classify the data sample and give prediction for the given test sample.

Week 11: Write a program to evaluate model accuracy using Leave-One-Out Cross validation on the models build using various methods.

Week 12:

- Demonstrate DBSCAN and OPTICS algorithms on the given dataset.
- Classify text segments (documents, paragraphs, collocations) into a set of predefined classes.

Text Books:

- Jiawei Han and M Kamber, Data Mining Concepts and Techniques, 2nd Edition, Elsevier Publication, 2011.
- Vipin Kumar, Pang-Ning Tan, and Michael Steinbach, Introduction to Data Mining, Addison Wesley, 2006.

Reference Books:

- Arun K Pujari, Data Mining Techniques, 3rd Edition, Universities Press.
- Pualraj Ponnaiah, Data Warehouse Fundamentals, Wiley Student Edition.
- G Dong and J Pei, Sequence Data Mining, Springer, 2007.
- VikaramPudi and P Radha Krishna, Data Mining, Oxford University Press.

Online Resources:

1. <https://docs.google.com/file/d/0B5Ju2x50v6l5X0p3WDEwNkNTVW8/edit>
2. <https://www.kdnuggets.com/websites/index.html>
3. <https://www.ngdata.com/data-mining-resources/>

Course Outcomes:

After completion of the course, students will be able to

1. Understand the concepts of frequent patterns, association and correlations in data mining.
2. Perform classification and prediction techniques on large data sets.
3. Analyze various clustering techniques.
4. Comprehend the technique to extract patterns from time series data and its applications in real world.
5. Apply and analyze the knowledge of Web mining.
6. Solve real world problems in business and scientific information using data mining.

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RESEARCH METHODOLOGY AND IPR

Prerequisites: English.

Course Objectives:

1. To develop an understanding of IPR/ research methodology in the process of creation of patents through research.
2. To develop further research capabilities.
3. To learn better report writing skills and Patenting.

UNIT 1: (~ 8 Lecture Hours)

Research Methodology: Objectives and Motivation of Research, Significance of Literature review, Types of Research, Research Approaches, and Research Methods verses Methodology, Research and Scientific Method, Importance of Research Methodology, Research Process, Criteria of Good Research.

UNIT 2: (~ 8 Lecture Hours)

Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Data collection methods, Collection of primary data, Secondary data, Data organization, Methods of data grouping, Diagrammatic representation of data, Graphic representation of data.

UNIT 3: (~ 6 Lecture Hours)

Research Report Writing: Format of the Research report, Synopsis, Dissertation, References/Bibliography/Webliography, Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal.

UNIT 4: (~ 4 Lecture Hours)

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.

UNIT 5: (~ 4 Lecture Hours)

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. New Developments in IPR: Administration of Patent System.

Text Books:

1. C.R Kothari, "Research Methodology, Methods & Technique", New Age International Publishers, 2004.
2. R. Ganesan, "Research Methodology for Engineers", MJP Publishers, 2011.
3. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
4. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.
5. Satarkar, S.V., "Intellectual property rights and copy right". ESS Publications, 2000.

Reference Books:

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners.
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007

Course Outcomes:

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

1. Understand research problem formulation.
2. Analyze research related information.
3. Follow research ethics.
4. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
5. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.
6. Compose and write quality research reports and attain familiarity with intellectual property rights.

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ENGLISH FOR RESEARCH PAPER WRITING
(Audit Course-1)

Prerequisites: -

Course Objectives:

1. To understand the nuances of language and vocabulary in writing a Research Paper.
2. To develop the content, structure and format of writing a research paper.
3. To give the practice of writing a Research Paper.
4. To enable the students to evolve original research papers without subjected to plagiarism.

UNIT 1: (~ 7 Lecture Hours)

Academic Writing

What is Research? - Meaning & Definition of a research paper- Purpose of a research paper – Scope – Benefits – Limitations – outcomes.

UNIT 2: (~ 7 Lecture Hours)

Research Format

Title – Abstract – Introduction – Discussion – Findings – Conclusion – Style of Indentation – Font size/Font types – Indexing – Citation of sources.

UNIT 3: (~ 6 Lecture Hours)

Research Methodology

Methods (Qualitative – Quantitative) – Literature Review – Who did what – Criticizing, Paraphrasing & Plagiarism.

UNIT 4: (~ 6 Lecture Hours)

Process of Writing a research paper

Choosing a topic - Thesis Statement – Outline – Organizing notes - Language of Research – Word order, Paragraphs – Writing first draft –Revising/Editing - Typing the final draft

UNIT 5: (~ 6 Lecture Hours)

How to & where to get published

Reputed Journals – National/International – ISSN No, No. of volumes, Scopes Index/UGC Journals – Free publications - Paid Journal publications – /Advantages/Benefits

Reference Books:

1. MLA Hand book for writers of Research Papers, East West Press Pvt. Ltd, New Delhi, 7th Edition.
2. C. R Kothari, Gaurav, Garg, Research Methodology Methods and Techniques, New Age International Publishers. 4th Edition.
3. Lauri Rozakis, Schaum's Quick Guide to Writing Great Research Papers, Tata McGraw Hills Pvt. Ltd, New Delhi.
4. N. Gurumani, Scientific Thesis Writing and Paper Presentation, MJP Publishers

Online Resources:

1. NPTEL: https://onlinecourses.nptel.ac.in/noc18_mg13/preview

Course Outcomes:

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

1. The student will be able to understand the nuances of research writing.
2. The student will be able to write a research paper with required writing skills and be confident to share their writing with others.
3. The student will be able to publish a paper using the requisite standard in a journal.
4. The student will be able to review the research papers and articles in a scientific manner.
5. The student will be able to work on citations and ably place them in her research paper.
6. The student will be able to avoid plagiarism and be able to develop her own writing skills in presenting the research work.

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DISASTER MANAGEMENT

(Audit Course-1)

Prerequisites: Awareness about Various Planetary & Extra Planetary Hazards, their Impacts & Mitigation measures

Course Objectives:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.
5. Students will get the overview on the roles of government and non-government agencies in disaster management.
6. Describe the basic concepts of the emergency management cycle (mitigation, preparedness, response and recovery) and their application on various types of disasters.

UNIT 1: (~ 8 Lecture Hours)

Introduction and Repercussions of Disasters and Hazards: Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude. Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT 2: (~ 5 Lecture Hours)

Disaster Prone Areas in India :Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with special reference to Tsunami; Post-Disaster Diseases and Epidemics.

UNIT 3: (~ 5 Lecture Hours)

Disaster Preparedness and Management Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT 4: (~ 5 Lecture Hours)

Risk Assessment Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation In Risk Assessment, Strategies for Survival.

UNIT 5: (~ 5 Lecture Hours)

Disaster Mitigation: Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation - Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Text Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.), "Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep&Deep Publication Pvt. Ltd., New Delhi.

Reference Books:

1. Disaster Management Guidelines. GOI-UNDP Disaster Risk Reduction Programme (2009-2012).
2. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003.
3. Satapathy S. (2009) Psychosocial care in Disaster management, A training of trainers manual (ToT), NIDM publication.
4. Guerisse P. 2005 Basic Principles of Disaster Medical Management. Act Anaesth. Belg;56:395-401
5. Aim and Scope of Disaster Management. Study Guide prepared by Sharman and Hansen. UW-DMC, University of Washington.

Online Resources:

1. <https://www.mooc-list.com/tags/earthquake>
2. <https://freevideolectures.com/course/3581/earthquakes-in-your-backyard>
3. <https://summer.uci.edu/online/>
4. <http://www.open.edu/openlearn/free-courses/full-catalogue>
5. <https://www.edx.org>
6. <https://www.disasterready.org/courses>

Course Outcomes:

After completion of the course, students will be able to

1. Learn different disasters and measures to reduce the risk due to these disasters.
2. Learn institutional frame work for disaster management at national as well as global level.
3. Develop the capacity to integrate knowledge and to analyze, evaluate and manage the different public health aspects of disaster events at a local and global levels, even when limited information is available.
4. Demonstrate, describe, analyze and evaluate the environmental, social, cultural, economic, legal and organizational aspects influencing vulnerabilities and capacities to face disasters.
5. Understand the emergency/disaster management cycle for various types of disasters.
6. Develop a basic understanding of prevention, mitigation, preparedness, response and recovery on various types of disasters.

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PEDAGOGY STUDIES
(Audit Course - 1)

Prerequisites: -

Course Objectives:

To enable the students

1. To understand the programme design and policies of pedagogy studies.
2. To develop knowledge, abilities and dispositions with regard to teaching techniques, curriculum design and assessment practices.
3. Analyze various theories of learning and their connection to teaching practice.
4. To familiarize the student with various research designs and research methods.
5. To create an awareness about the practices followed by DFID, other agencies and other researchers.
6. To identify critical evidence gaps to guide the development.

UNIT 1: (~ 8 Lecture Hours)

Introduction and Methodology:

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT 2: (~ 6 Lecture Hours)

Thematic overview: Pedagogical practices followed by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT 3: (~ 6 Lecture Hours)

Evidence on the effectiveness of pedagogical practices - Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and Practicum) and the school curriculum and guidance material best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and pedagogic strategies.

UNIT 4: (~ 6 Lecture Hours)

Professional development: alignment with classroom practices and follow up support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: Limited resources and large class sizes.

UNIT 5: (~ 6 Lecture Hours)

Research gaps and future directions - Research design - Contexts - Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

Reference Books:

1. Ackers J, Hardman F (2001) Classroom Interaction in Kenyan Primary Schools, *Compare*, 31 (2): 245 – 261.
2. Agarwal M (2004) Curricular Reform in Schools: The importance of evaluation, *Journal of Curriculum Studies*, 36 (3) : 361 – 379.
3. Akyeampong K, (2003) Teacher Training in Ghana – does it count? Multisite teacher education research project (MUSTER) Country Report 1. London: DFID
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of Basic Maths and Reading in Africa: Does teacher Preparation count? *International Journal Educational Development*, 33 (3): 272- 282.
5. Alexander R J (2001) *Culture and Pedagogy : International Comparisons in Primary Education*. Oxford and Boston : Blackwell.
6. Chavan M (2003) *Read India: A mass scale, rapid, 'learning to read' campaign*.
7. www.pratham.org/images/resources%20working%20paper%202.pdf.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc17_ge03/preview

Course Outcomes:

The students will be able to understand

1. The pedagogical practices followed by teachers in developing countries both in formal and informal classrooms.
2. To examine the effectiveness of pedagogical practices.
3. To understand the concept, characteristics and types of educational research and perspectives of research.
4. The role of teacher education, school curriculum and guidance materials for effective pedagogy

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**PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT
SKILLS**

(Audit Course-1)

Prerequisites: -

Course Objectives:

1. To learn to achieve the highest goal happily.
2. To become a person with stable mind, pleasing personality and determination.
3. To awaken wisdom in students.

UNIT 1: (~ 6 Lecture Hours)

Neetisatakam – Holistic development of personality - Verses 19, 20, 21, 22 (Wisdom) - Verses 29, 31, 32 (Pride and Heroism) - Verses 26,28,63,65 (Virtue)

UNIT 2: (~ 6 Lecture Hours)

Neetisatakam – Holistic development of personality (cont'd) - Verses 52, 53, 59 (don't's) - Verses 71,73,75 & 78 (do's) - Approach to day to day works and duties.

UNIT 3: (~ 7 Lecture Hours)

Introduction to Bhagavadgeetha for Personality Development - Shrimad BhagawadGeeta: Chapter 2 – Verses 41, 47, 48 - Chapter 3 – Verses 13,21,27,35 - Chapter 6 – Verses 5,13,17,23,35 - Chapter 18 – Verses 45, 46, 48

UNIT 4: (~ 7 Lecture Hours)

Statements of basic knowledge - Shrimad BhagawadGeeta: Chapter 2- Verses 56, 62,68 - Chapter 12 – Verses 13, 14, 15, 16, 17, 18 - Personality of Role model from Shrimad BhagawatGeeta.

UNIT 5: (~ 6 Lecture Hours)

Role of Bahgavadgeeta in the present scenario - Chapter 2 – Verses 17 - Chapter 3 – Verses 36, 37, 42 - Chapter 4 – Verses 18, 38, 39 - Chapter 18 – Verses 37, 38, 63.

Text Books:

1. Srimad Bhagavad Gita by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata.
2. Bhartrihari'sThriSatakam (Niti – Sringer- Vairagya) by P. Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Online Courses:

1. NTPEL: <http://nptel.ac.in/downloads/109104115/>

Course Outcomes:

The student will be able to

1. Develop their personality and achieve their highest goal of life.
2. Lead the nation and mankind to peace and prosperity.
3. Develop versatile personality.

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ADVANCED ALGORITHMS
(Common to CSE & CNIS)

Prerequisites: Design and Analysis of Algorithms.

Course Objectives:

1. Introduce advanced methods of designing and analysing algorithms.
2. Choose appropriate algorithms and use it for a specific problem.
3. Familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems.
4. Introduce the recent developments in the area of algorithmic design.

UNIT 1: (~ 10 Lecture Hours)

Sorting: Searching- Linear search and Binary search using Normal array & Skip list, Internal and External sorting, Heapsort, Quicksort, Sorting in linear time, Emphasis on correctness proof of the algorithm and time/space analysis.

UNIT 2: (~ 10 Lecture Hours)

Graph: Elementary Graph Algorithms, MST, Single-Source Shortest Path, All Pair Shortest Path

Maximum Flow: Flow Networks, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm.

UNIT 3: (~ 9 Lecture Hours)

Divide-and-Conquer: Introduction, The Maximum-subarray problem, Stassen's algorithm for matrix multiplication, Substitution Method, Recurrence –Tree Method, Master Method, Proof of Master Theorem.

UNIT 4: (~ 8 Lecture Hours)

Dynamic Programming: Rod Cutting, Matrix Chain Multiplication, Elements of dynamic programming, Longest common subsequence, Optimal binary search tree.

Polynomials: Representing Polynomials, DFT and FFT.

UNIT 5: (~ 8 Lecture Hours)

Linear Programming: Introduction, The simplex algorithm, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm.

NP Completeness: Polynomial time, Polynomial time verification, NP-Completeness and reducibility, NP Complete Problems.

Text Books:

1. Cormen, Leiserson, Rivest, and Stein, "Introduction to Algorithms", 3rd Edition, MIT Press, 1990.

Reference Books:

1. Mark A. Weiss, Data Structures and Algorithm Analysis in Java, 3rd Edition, Pearson, 2012.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "The Design and Analysis of Computer Algorithms", 1st Edition, Addison-Wesley Publication, 1974.
3. Jon Kleinberg and Eva Tardos, "Algorithm Design", 1st Edition, Pearson, 2006.
4. Sartaj Sahni, "Data Structures, Algorithms and Applications in JAVA", 2nd Edition, Universities Press, 2005.

Online Resources:

1. <http://nptel.ac.in/courses/106104019/>

Course Outcomes:

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

1. Analyse the complexity/performance of different algorithms.
2. Determine the appropriate design paradigm for solving a particular set of problems.
3. Categorize the different problems in various classes according to their complexity.
4. Formulate algorithms for NP hard and NP complete problems.
5. Develop linear programming algorithms
6. Analyse and write efficient algorithms for any complex/ real world problems.

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SOFT COMPUTING

Prerequisites: -

Course Objectives:

1. Introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.
2. Implement soft computing based solutions for real-world problems.
3. Give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic and genetic algorithms.
4. Provide student a hand-on experience on Python to implement various strategies.

UNIT 1: (~ 7 Lecture Hours)

Introduction to Soft Computing and Neural Networks:

Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics: Supervised, Unsupervised and Reinforcement Learning.

UNIT 2: (~ 10 Lecture Hours)

Fuzzy Logic: Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making, Study of fuzzy logic toolbox.

UNIT 3: (~ 11 Lecture Hours)

Neural Networks: Machine Learning using Neural Network Basics.

Supervised Learning Neural Networks: Introduction, Perceptrons, Adaline, Backpropagation Multilayer Perceptrons, Radial Basis Function Networks, Modular Networks, Study of Neural Network toolbox.

Adaptive Networks: Architecture, Backpropagation for Feed forward Networks, Extended Backpropagation for Recurrent Networks, Hybrid Learning Rule.

UNIT 4: (~ 10 Lecture Hours)

Advanced Neural Networks

Unsupervised Learning Neural Networks: Introduction, Competitive Learning Networks, Kohonen Self-Organizing Networks, Hebbian Learning, Principle Component Networks, Hopfield Networks.

Reinforcement Learning: Q-Learning, Simple implementation of Artificial Neural Network and Fuzzy Logic.

UNIT 5: (~ 10 Lecture Hours)

Genetic Algorithms: Introduction, Biological Background, Traditional optimization and search techniques, Search Space, Genetic Algorithm Vs Traditional Algorithms, Basic Terminologies, Simple and General GA, Operators in GA, Stopping Condition for GA flow, Problem solving using GA, Classification of GA's: Messy, Adaptive, Hybrid and parallel. Applications of GA.

Text Books:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun and Eiji Mizutani, Neuro Fuzzy and Soft Computing, Prentice Hall of India/PHI, 2003.
2. S.N Sivanandam and S.N. Deepa, Principles of Soft Computing, Wiley India, 2007.

Reference Books:

1. David E Goldberg, Genetic Algorithms in Search Optimization and machine learning, Addison-Wesley, 1989.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall, 1995.
3. Russell and Norvig, Artificial intelligence, A Modern Approach, Pearson Education, Second Edition. 2004.

Online Resources:

1. www.soukalfi.edu.sk/01_NeuroFuzzyApproach.pdf
2. <https://drive.google.com/file/d/0B0z1V-RAPGVkT2MyTXlwdE9XWXc/view?usp=sharing>
3. <https://github.com/rohanchikorde/Data-Science-books/blob/master/python-machine-learning-2nd.pdf>
4. http://www.myreaders.info/html/soft_computing.html

Course Outcomes:

After completion of the course, students will be able to

1. Identify and describe soft computing techniques and their roles in building intelligent machines.
2. Understand and apply concept of artificial neural networks.
3. Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
4. Apply genetic algorithms to combinatorial optimization problems.
5. Evaluate and compare solutions by various soft computing approaches for a given problem.
6. Recognize the underlying mathematics and logic behind various soft computing algorithms.

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DATA PREPARATION AND ANALYSIS

(Program Specific Elective- 3)

Prerequisites: Data Mining, Probability & Statistics.

Course Objectives:

1. This course surveys industrial and scientific applications of data analytics.
2. How to prepare data for analysis.
3. Perform exploratory data analysis and develop meaningful data visualizations.
4. Learn how to prepare datasets for analysis by cleaning and reformatting.
5. Apply a variety of different data exploration techniques like statistics and visualization methods.

UNIT 1: (~ 8 Lecture Hours)

Data Gathering and Preparation: Overview, Data sources.

Data formats: Data understanding, Data tables, Continuous and Discrete variables, Scales of measurement, Roles in analysis, Frequency distribution.

UNIT 2: (~ 10 Lecture Hours)

Data Cleaning: Overview, Consistency Checking.

Heterogeneous and missing data: Cleaning the Data, Removing variables, Data Transformation and segmentation.

UNIT 3: (~ 10 Lecture Hours)

Exploratory Analysis:

Statistics: Overview, Descriptive and comparative statistics.

Grouping: Clustering - Overview, Hierarchical Agglomerative clustering, K-Means Clustering, Association Rules - Overview, Grouping value combinations, Extracting rules from groups, Examples.

UNIT 4: (~ 10 Lecture Hours)

Visualization-1:

Designing Visualizations: Why data display requires planning, An Example, Iteration and Combination, Principles.

Time series: Acquire and Parse, Cleaning the Table, A simple plot, Labeling the current data set, Drawing Axis Labels, Choosing a proper representation, Ways to connect points, Interpolation between Data sets.

UNIT 5: (~ 8 Lecture Hours)

Visualization-2:

Correlations and connections: Changing data sources, Problem statement, Preprocessing, Using the Preprocessed Data, Displaying the results.

Hierarchies and networks: Flying through Files, Approaching network problems.

Text Books:

1. Glenn J. Myatt, Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, John Wiley & Sons, Inc, 2007.
2. Ben Fry, Visualizing Data: Exploring And Explaining Data With The Processing Environment, O'Reilly Media, Inc, 2007.

Reference Books:

1. Edward R. Tufte, The Visual display of Quantitative information, Second Edition, Graphics Press, 2001.
2. Tamraparni Dasu, Exploratory Data Mining and Data Cleaning, John Wiley, 2003.

Online Resources:

1. <https://www.safaribooksonline.com/library/view/visualizing-data/9780596514556/ch08.html>.
2. <https://www.scribd.com/document/54993779/Making-Sense-of-Data-a-Practical-Guide-to-Exploratory-Data-Analysis-and-Data-Mining>

Course Outcomes:

After completion of the course, students will be able to

1. Understand the concepts of data gathering and preparation.
2. Ability to perform data cleaning techniques on data sets.
3. Analyze various data transformation and segmentation techniques.
4. Apply and analyze the various clustering techniques.
5. Able to comprehend visualize the data related to real world applications.
6. Ability to solve correlations and connections, hierarchies and networks in business and scientific information using processing environment.

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COMPUTER VISION
(Program Specific Elective- 3)

Prerequisites: -

Course Objectives:

1. Familiarize the students with the theoretical aspects of computing with images.
2. Understand the foundation of image formation and analysis.
3. Feature extraction using Histogram Processing, Color, Edges, Texture and shape.
4. Applying basic mathematical morphology concepts and segmentation.
5. Identifying different patterns using various pattern analysis techniques.

UNIT 1: (~ 9 Lecture Hours)

IMAGE PROCESSING: Fundamental steps of image processing, the image model and Image acquisition, Sampling and quantization, Relationship between pixels.

LINEAR FILTERS: Introduction to Computer Vision, Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, A Continuous Model of a Sampled Signal, Aliasing, Technique: Scale and Image Pyramids.

UNIT 2: (~ 8 Lecture Hours)

EDGE DETECTION: Noise-Additive Stationary Gaussian Noise, Why Finite Differences Respond to Noise, Estimating Derivatives - Derivative of Gaussian Filters, Why Smoothing Helps, Choosing a Smoothing Filter, Why Smooth with a Gaussian? Detecting Edges-Using the Laplacian to Detect Edges, Gradient-Based Edge Detectors, Technique: Orientation Representations and Corners.

UNIT 3: (~ 10 Lecture Hours)

FEATURE EXTRACTION: Histogram Processing, Color: Color Fundamentals, Color Models, Texture: Representing Texture-Extracting Image Structure with Filter Banks, Representing Texture Using the Statistics of Filter Outputs, Analysis (and Synthesis) Using Oriented Pyramids -The Laplacian Pyramid, Filters in the Spatial Frequency Domain, Oriented Pyramids, Application: Synthesizing Textures for Rendering, Homogeneity, Synthesis by Sampling Local Models, Shape from Texture, Shape from Texture for Planes, Shape from Texture for Curved Surfaces.

UNIT 4: (~ 9 Lecture Hours)

MATHEMATICAL MORPHOLOGY: Erosion and Dilation, Opening and Closing.

SEGMENTATION BY CLUSTERING: What is Segmentation, Human Vision: Grouping and Gestalt, Applications: Shot Boundary Detection and Background Subtraction, Image Segmentation by Clustering Pixels, Segmentation by Graph-Theoretic Clustering. The Hough Transform, Fitting Lines, Fitting Curves.

UNIT 5: (~ 9 Lecture Hours)

PATTERN ANALYSIS: Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Supervised, Un-supervised, Semi supervised, Classifiers: Bayesian Statistics, KNN, Dimensionality Reduction: PCA, ICA.

Text Books:

1. R C Gonzalez and R E Woods, Addison, Digital Image Processing, Third Edition, Pearson, 2008.
2. David A. Forsyth and Jean Ponce, Computer Vision-A Modern Approach, First Edition, PHI, 2003.
3. Goodfellow, Bengio, and Courville, Deep Learning, First Edition, MIT Press, 2016.

Reference Books:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, First edition, Springer, 2010.
2. Robert B. Fisher, Toby P. Breckon, Kenneth Dawson-Howe, Andrew Fitzgibbon, Craig Robertson, Emanuele Trucco and Christopher K.I. Williams, Dictionary of Computer Vision and Image Processing, Second edition, WILEY Publications, 2014.

Online Resources:

1. <https://computervisiononline.com>
2. <http://groups.csail.mit.edu/vision/courses/6.869/materials.html>
3. <http://www.cl.cam.ac.uk/teaching/1516/CompVision/materials.html>

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 edge detection techniques.
3. Extract features using Histogram Processing, different color models and shape from texture.
4. Apply basic morphological operations.
5. Analyze segmentation of images by clustering pixels and Segmentation by Graph-Theoretic Clustering.
6. Evaluate patterns using classification and clustering techniques.

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DISTRIBUTED DATABASES

(Program Specific Elective- 3)
(Common to CSE & CNIS)

Prerequisites: Data Base Management Systems.

Course Objectives:

1. The objective of the course is to learn the management of distributed data using distributed database management systems.
2. Will acquire insight into difference between the centralized databases and distributed databases.
3. Understand distributed DBMS architecture, query decomposition and data localization.
4. Learn the techniques of transaction management, distributed concurrency control, client/server architectures and distributed multi-DBMSs.

UNIT 1: (~ 8 Lecture Hours)

Distributed Databases: Features of Distributed versus Centralized Databases, Principles of Distributed Databases.

Levels Of Distribution Transparency: Reference Architecture for Distributed Databases, Types of Data Fragmentation, Integrity Constraints in Distributed Databases, Distributed Database Design.

UNIT 2: (~ 9 Lecture Hours)

Translation of Global Queries to Fragment Queries: Equivalence transformations for Queries, Transforming Global Queries into Fragment Queries, Distributed Grouping and Aggregate Function Evaluation, Parametric Queries.

Optimization of Access Strategies: A Framework for Query Optimization, Join Queries, General Queries.

UNIT 3: (~ 10 Lecture Hours)

The Management of Distributed Transactions: A Framework for Transaction Management, Supporting Atomicity of Distributed Transactions, Concurrency Control for Distributed Transactions, Architectural Aspects of Distributed Transactions.

Concurrency Control: Foundation of Distributed Concurrency Control, Distributed Deadlocks, Concurrency Control based on Timestamps, Optimistic

Methods for Distributed Concurrency Control.

UNIT 4: (~ 9 lectures)

Reliability: Basic Concepts, Nonblocking Commitment Protocols, Reliability and concurrency Control, Determining a Consistent View of the Network, Detection and Resolution of Inconsistency, Checkpoints and Cold Restart.

Distributed Database Administration: Catalog Management in Distributed Databases, Authorization and Protection.

UNIT 5: (~ 10 Lecture Hours)

Distributed Object Database Management Systems: Architectural Issues, Alternative Client/Server Architectures, Cache Consistency, Object Management, Object Identifier Management, Pointer Swizzling, Object Migration, Distributed Object Storage, Object Query Processing, Object Query Processor Architectures, Query Processing Issues, Query Execution, Transaction Management, Transaction Management in Object DBMSs, Transactions as Objects.

Database Interoperability: Database Integration, Scheme Translation, Scheme Integration, Query Processing, Query Processing Layers in Distributed Multi-DBMSs, Query Optimization Issues, Transaction Management, Transaction and Computation Model, Multidatabase Concurrency Control, Multidatabase Recovery, Object Orientation and Interoperability, Object Management Architecture, CORBA and Database interoperability, Distributed Component Object Model, COM/OLE and Database Interoperability.

Current Issues: PUSH-Based Technologies.

Text Books:

1. Stefano Ceri and Giuseppe Pelagatti, Distributed Databases Principles & Systems, TMH.1985.
2. M. Tamer Ozsu and Patrick Valduriez, Principles of Distributed Database Systems, Pearson Education, 2nd Edition.

Reference Books:

1. Chhanda Ray and Ray, Distributed Database Systems, Pearson education India, 2009.
2. Saeed K.Rahimi and Frank S.Haug, Distributed Database Management System-A Practical Approach, Wiley Publisher, 2010.

Online Resources:

1. <http://pcbunn.cithec.caltech.edu/DistributedDatabasesPakistan.pdf>
2. <http://web.cs.wpi.edu/~cs561/s12/LectureHours/4-5/DistributedDBs.pdf>
3. <https://www.tutorialspoint.com>

Course Outcomes:

After completion of the course, students will be able to

1. Differentiate key concepts and techniques for centralized databases and distributed databases.
2. Analyze and design distributed database systems based on the principles of distributed indexing, query evaluation, data replication.
3. Implement storage, indexing, query evaluation and query optimization techniques.
4. Implement the concepts of transaction management, concurrency control, crash recovery, deadlocks and catalog management.
5. Apply suitable architecture for distributed databases.
6. Apply the concepts of inter-operability of databases.

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HUMAN COMPUTER INTERACTION
(Program Specific Elective- 4)

Prerequisites: -

Course Objectives:

1. Learn the foundations of Human Computer Interaction.
2. Be familiar with the design technologies for individuals and persons with disabilities.
3. Be aware of mobile Human Computer interaction.
4. Learn the guidelines for user interface.

UNIT 1: (~ 9 Lecture Hours)

Human: I/O channels – Memory – Reasoning and problem solving.

The computer: Devices – Memory – processing and networks.

Interaction: Models – Frameworks – Ergonomics – styles – elements – interactivity.

UNIT 2: (~ 8 Lecture Hours)

Interactive Design basics: Process – scenarios – navigation – screen design and layout–Iteration and prototyping.

HCI in software process: Software life cycle –Usability engineering – Prototyping in practice – design rationale.

UNIT 3: (~ 11 Lecture Hours)

Design rules: Principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.

Cognitive models: Socio-Organizational issues and stakeholder requirements– Communication and collaboration models.

UNIT 4: (~ 9 Lecture Hours)

Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile.

Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0. **Mobile Design:** Elements of Mobile Design, Tools.

UNIT 5: (~ 8 Lecture Hours)

Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow.

Recent Trends: Speech Recognition and Translation, Multimodal System.

Text Books:

1. Alan Dix, Janet Finlay and Gregory Abowd, Russell Beale, “Human Computer Interaction”, 3rd Edition, Pearson Education, 2004.
2. Brian Fling, “Mobile Design and Development”, First Edition , O Reilly Media Inc., 2009.
3. Bill Scott and Theresa Neil, “Designing Web Interfaces”, 1st Edition, O Reilly, 2009.

Reference Books:

1. Ben Shneiderman, Designing the user interface, 3rd Edition, Pearson Education Asia.
2. Wilbert O Galitz, The essential guide to user interface design, 2nd Edition, Wiley.
3. Sharp Rogers Preece, Interaction Design Beyond Human-Computer Interaction, , 2nd Edition, Wiley Dreama Tech.

Online Resources:

1. http://www.tutorialspoint.com/sdlc/sdlc_overview.htm
2. https://www.w3schools.com/howto/howto_website.asp

Course Outcomes:

After completion of the course, students will be able to

1. Explain importance of HCI study and principles of user-centred design (UCD) approach.
2. Develop understanding of human factors in HCI design.
3. Develop understanding of models, paradigms and context of interactions.
4. UCD process to design effective user-interfaces following a structured and organized.
5. Evaluate usability of a user-interface design.
6. Apply cognitive models for predicting human-computer-interactions.

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DIGITAL FORENSICS
(Program Specific Elective- 4)
(Common to CSE & CNIS)

Prerequisites: Computer Networks.

Course Objectives:

1. Provides an in-depth study of the rapidly changing and fascinating field of computer forensics.
2. Combines both the technical expertise and the knowledge required to investigate, detect and prevent digital crimes.
3. Knowledge on digital forensics legislations, digital crime, forensics processes and procedures, data acquisition and validation, e-discovery tools.
4. E-evidence collection and preservation, investigating operating systems and file systems, network forensics, art of steganography and mobile device forensics.

UNIT 1: (~ 9 Lecture Hours)

Digital Forensics Science: Forensics science, computer forensics, and digital forensics.

Computer Crime: Criminalistics as it relates to the investigative process, analysis of cyber-criminalistics area, holistic approach to cyber-forensics.

UNIT 2: (~ 8 Lecture Hours)

Cyber Crime Scene Analysis: Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.

UNIT 3: (~ 9 Lecture Hours)

Evidence Management & Presentation: Create and manage shared folders using operating system, importance of the forensic mindset, define the workload of law enforcement, Explain what the normal case would look like, Define who should be notified of a crime, parts of gathering evidence, Define and apply probable cause.

UNIT 4: (~ 10 Lecture Hours)

Computer Forensics: Prepare a case, Begin an investigation, Understand computer forensics workstations and software, Conduct an investigation, Complete a case, Critique a case.

Network Forensics: Open-source security tools for network forensic analysis, requirements for preservation of network data.

UNIT 5: (~ 12 Lecture Hours)

Mobile Forensics: Mobile forensics techniques, Mobile forensics tools.

Legal Aspects of Digital Forensics: IT Act 2000, amendment of IT Act 2008.

Recent trends in mobile forensic technique and methods to search and seizure electronic evidence.

Text Books:

1. John R. Vacca, Computer Forensics, Computer Crime Scene Investigation, 2nd Edition, Charles River Media, Inc.
2. John Sammons, The Basics of Digital Forensics, Elsevier.

Reference Books:

1. Tony Sammes and Brian Jenkinson, Forensic Computing, A Practitioner's Guide, Springer International edition.
2. Dr. Darren R. Hayes, A Practical Guide to Computer Forensics Investigations Pearson Education Inc.
3. Christopher L.T. Brown, Computer Evidence: Collection and Presentation, 2nd Edition, Cengage Learning.
4. Robert M. Slade, Software Forensics Collecting Evidence from the Scene of a Digital Crime, 1st Edition, TMH.

Online Resources:

1. <https://www.cs.nmt.edu/~df/LectureHours.html>
2. https://booksite.elsevier.com/samplechapters/9780123742681/Chapter_1.pdf
3. https://www.cs.purdue.edu/homes/ninghui/courses/426_Fall10/handouts/CS426_forensics.pdf

Course Outcomes:

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

1. Understand relevant legislation and codes of ethics.
2. Computer forensics and digital detective and various processes, policies and procedures.
3. E-discovery, guidelines and standards, E-evidence, tools and environment.
4. Email and web forensics and network forensics.
5. Understand procedures for network forensics.
6. Understand various forensic tools for a wide variety of investigations.

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CLUSTER AND GRID COMPUTING
(Program Specific Elective- 4)

Prerequisites: Computer Networks.

Course Objectives:

1. An insight for achieving cost efficient high performance system.
2. Understand the design and architecture of grid and cluster computing.
3. Recent trends and case study for cluster computing.

UNIT 1: (~ 9 Lecture Hours)

Introduction: Cluster and Grid computing, Meta-computing, Web services and Grid Computing, e-Governance and the Grid Technologies and Architectures for Grid Computing: Issues in Data Grids, Functional requirements in Grid Computing, Standards for Grid Computing, Recent technology trends in Large Data Grids.

Web Services and the Service Oriented Architecture: Service Oriented Architecture, SOAP and WSDL, Creating Web Services, Server Side.

UNIT 2: (~ 9 Lecture Hours)

OGSA and WSRF: OGSA for Resource Distribution, Stateful Web Services in OGSA, WSRF, WSRF Specification, Globus Toolkit: History, Version, Applications, Approaches and Benefits, Infrastructure Management, Monitoring and Discovery, Security, Data Choreography and Coordination, GT4 Architecture, GT4 Containers.

The Grid and Databases: Requirements, Storage Request Broker, Integration of Databases with the Grid, Architecture of OGSA-DAI for offering Grid Database services.

UNIT 3: (~ 10 Lecture Hours)

Cluster Computing: Approaches to Parallel Computing, Definition and Architecture of a Cluster, Categories of clusters.

Cluster Middleware: Levels and Layers of Single System Image, Design objectives, Resource Management and Scheduling, Cluster programming Environment and Tools.

Networking, Protocols & I/O for clusters: Networking and Interconnection/Switching Devices, Design Issues, Design Architecture, HiPPI, ATM, Myrinet, Memory Channel.

UNIT 4: (~ 8 Lecture Hours)

Setting Up and Administering a Cluster: Setup of simple cluster, setting upnodes, clusters of clusters, System monitoring, Global Clocks Sync. Cluster.

Technology for High Availability: High availability clusters, high availability parallel computing, types of failures and errors, cluster architectures and configurations for high availability, Failure/Recovery clusters.

UNIT 5: (~ 10 Lecture Hours)

Process Scheduling: Job management System, Resource management system, policies of resource utilization, Scheduling policies.

Load Sharing and Load Balancing: Introduction, Strategies for load balancing, Modeling parameters.

Recent trends: technologies and attributes in Cluster and Grid computing. Case study of various cluster architectures, load balancing and scheduling policies.

Text Book:

1. C.S.R. Prabhu, Grid and Cluster Computing, Kindle Edition, PHI, 2005.

Reference Books:

1. Joshy Joseph and Craig Fellenstein, Grid Computing, 1/e, Pearson Education, India.
2. D. Janakiram, Grid Computing, Tata Mc Graw Hill, 2005.

Online Resources:

1. http://www.vssut.ac.in/lecture_notes/lecture1428643084.pdf
2. <http://www.cs.kent.edu/~farrell/grid06/LectureHours/index.html>
3. <https://www.redbooks.ibm.com/redbooks/pdfs/sg246778.pdf>

Course Outcomes:

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

1. Gain knowledge of Grid Computing, Web Services, and Service-oriented architecture.
2. Illustrate the architecture for grid computing.
3. Get knowledge for setting up and administering a Cluster.
4. Understand the strategies for process scheduling and load balancing.
5. Know the recent trends in Cluster and Grid Computing.
6. Understand the case studies for various cluster architectures.

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ADVANCED ALGORITHMS LAB

(Common to CSE & CNIS)

Prerequisites: Java Programming.

Course Objectives:

1. Write and execute programs in Java to implement advanced algorithms.
2. Choose an appropriate design paradigm to solve problems.

Week 1: Write Java programs to implement the following using arrays or linked list.

- a) Priority Queue
- b) Heap Sort

Week 2: Write Java programs to implement and analyse the Quicksort performance.

Week 3: Write a Java program to implement the following

- a) Prim's Algorithm
- b) Kruskal's Algorithms

Week 4: Write a Java program to implement the functions following

- a) Single-Source Shortest Path
- b) All Pairs Shortest Path

Week 5: Write a Java program to analyse the Edmond-karp Algorithm.

Week 6: Write a Java program to implement the following

- a) Maximum Sub-array problem
- b) Strassen's Matrix Multiplication

Week 7: Write a Java program to implement the following

- a) Rod cutting
- b) Longest Common Subsequence

Week 8: Write a Java program to implement the Matrix Chain Multiplication.

Week 9: Write a Java program that implements Optimal Binary Search Tree (OBST).

Week 10: Write a Java program that implements the DFT.

Week 11: Write a Java program that implements the FFT.

Week 12: Write a Java program to implement Simplex Algorithm.

Reference Books:

1. Mark A. Weiss, Data Structures and Algorithm Analysis in Java, 3rd Edition, Pearson, 2012.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "The Design and Analysis of Computer Algorithms", 1st Edition, Addison-Wesley Publication, 1974.
3. Jon Kleinberg and Eva Tardos, "Algorithm Design", 1st Edition, Pearson, 2006.
4. Sartaj Sahni, "Data Structures, Algorithms and Applications in JAVA", 2nd Edition, Universities Press, 2005.

Online Resources:

1. <https://www.hackerrank.com>
2. www.spoj.com

Course Outcomes:

After completion of the course, students will be able to

1. Analyze and implement advanced sorting and searching techniques.
2. Solve problems related to divide and conquer strategy.
3. Implement greedy method problems.
4. Develop the dynamic programming algorithms and analyse it to determine its computational complexity.
5. Implement linear programming algorithms.
6. Analyse and write efficient algorithms for any complex/real world problems.

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DATA PREPARATION AND ANALYSIS LAB

(Program Specific Elective- 3)

Prerequisites: -

Course Objectives:

1. Understanding the Datasets and Pre-processing.
2. Intended to obtain hands-on experience using data analysis application.
3. Intended to provide practical exposure of clustering and association rules mining.
4. How to prepare data for analysis.
5. Apply a variety of different data exploration techniques like statistics and visualization methods.

Implement the following programs:

Load any one dataset and perform following activities

Week 1: List all the categorical (or nominal) attributes and the real-valued attributes separately.

Week 2: What attributes do you think might be crucial in building the any data set?

Week 3:

- a) Apply the cleaning process for the dataset (Replace Missing values).
- b) Do you really need to input so many attributes to get good results? May be only a few would do. For example, you could try just having some combination of attributes, the class attribute (naturally). Try out some combinations. (You had removed two attributes from the data set. Remember to reload the arff data file to get all the attributes initially before you start selecting the ones you want.)
- c) Implement the discretization on any data set.

Week 4: Demonstrate performing clustering on data sets.

Week 5: Perform data pre-processing tasks and demonstrate performing association rule mining on data sets.

Week 6, 7 and 8: Load the mlb dataset and write a program to:

- a. Explore how relationships can be instantly and powerfully conveyed through the spatial arrangement of data, visual

elements such as icons and lines, and most significantly, the use of animation.

- b. Loading Text Data.
- c. Files Too Large for loadStrings()
- d. Reading Files Progressively.
- e. Reading Files Asynchronously with a Thread.
- f. Parsing Large Files As They Are Acquired.

Week 9, 10, 11 and 12: Load Milk, Tea, and Coffee dataset and perform the following activities

- a. Write a program to Acquiring a table of data from a text file.
- b. Write a program to perform parsing the contents of the file into a usable data structure.
- c. Write a program to calculate the boundaries of the data to facilitate representation.
- d. Write a program to find a suitable representation and considering alternatives.
- e. Write a program to refine the representation with consideration for placement, type, line weight, and color.
- f. Design an application by providing a means of interacting with the data so that the variables can be compared against one another or against the average of the whole data set.

Text Books:

- 1. Glenn J. Myatt, Making sense of Data : A practical Guide to Exploratory Data Analysis and Data Mining, John Wiley & Sons, Inc, 2007.
- 2. Ben Fry, Visualizing Data: Exploring And Explaining Data With The Processing Environment, O'Reilly Media, Inc, 2007.

Reference Books:

- 1. Robert Wysocki, Effective Project Management: Traditional, Agile, Extreme, Sixth edition, Wiley India, 2011.
- 2. Watts S. Humphrey An Introduction to the Team Software Process, Pearson Education, 2000.
- 3. James R. Persse, Process Improvement essentials, O'Reilly, 2006.
- 4. Bob Hughes & Mike Cotterell, Software Project Management, fourth Edition, TMH, 2006.
- 5. Andrew Stellman & Jennifer Greene, Applied Software Project Management, O'Reilly, 2006.

Online Resources:

- 1. <https://www.safaribooksonline.com/library/view/visualizing-data/9780596514556/ch08.html>.

2. <https://www.scribd.com/document/54993779/Making-Sense-of-Data-a-Practical-Guide-to-Exploratory-Data-Analysis-and-Data-Mining>

Course Outcomes:

After completion of the course, students will be able to

1. Apply pre-processing statistical methods for any given raw data.
2. Ability to perform heterogeneous, cleaning techniques to replace missing data.
3. Analyze various data transformation techniques on various data sets.
4. Apply and analyze the various clustering techniques.
5. Ability to generate different association rules by applying various techniques.
6. Comprehend visualize the data related to in real world applications.

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COMPUTER VISION LAB
(Program Specific Elective- 3)

Prerequisites: -

Course Objectives:

1. Make students acquainted with practical aspects of computing with images.
2. Improving quality of image by applying enhancement techniques.
3. Extract features using Histogram processing, Color, Edges, Texture.
4. Apply mathematical morphological operations based on shapes.
5. Implement various pattern analysis techniques.

Use any tool like OpenCV/ Scilab/ R Programming etc.,

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: Write a program for texture feature extraction of a given image.

Week 9: Apply Hough transformation on the given image to detect lines.

Week 10: Write a program to segment an image by K-Means clustering.

Week 11: Classify the given images using Naïve Bayesian classifier.

Week 12: Write a program to reduce dimensionality using PCA for the given images.

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>

Course Outcomes:

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

1. Understand the basic image processing techniques and enhance images by adjusting contrast.
2. Detect edges using various kernels, detect lines using Hough transformation.
3. Apply histogram processing, convert between various colour spaces and obtain texture.
4. Analyze the morphological operations erosion, dilation, opening and closing.
5. Partition dataset by classification and clustering.
6. Comprehend computer vision system for real world problems.

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DISTRIBUTED DATABASES LAB

(Program Specific Elective- 3)

Prerequisites: Database Management Systems.

Course Objectives:

1. The objective of the course is to learn to design the database.
2. To able to understand active databases.
3. Management of distributed data using distributed database management systems.
4. To acquire insight into difference between the centralized databases and distributed databases.
5. Understand the deadlock in the context of distributed database.

Week 1: Experiments on SQL Commands, joins.

Week 2-3: Experiments on constraints and functions.

Week 4-6: Design and implement library management system in RDBMS

- a) Collect the essential requirements for library management system such as student details, book details, and issue.
- b) Define the entity sets and the attributes for library management system
 - i. Student details – stud name, studno.
 - ii. Book details – bookno, title, author name, book type.
- c) Define the Relationship sets such as lender, borrower, and issue.
- d) Represent the strong and weak entity sets.
- e) Design E-R diagram for library management system.

Week 7: Reduce the E-R schema of library management system into tables using generalization and aggregation.

Week 8: Active Database – Implementation of Triggers & Assertions for Bank Database.

Week 9-10: Develop a distributed database of BookStore at four sites.

Week 11: Write SQL queries for distributed database of BookStore.

Week 12: Deadlock Detection Algorithm for distributed database using wait-for graph.

Text Books:

1. Stefano Ceri and Giuseppe Pelagatti, Distributed Databases Principles & Systems, TMH, 1985.
2. M. Tamer Ozsu and Patrick Valduriez, Principles of Distributed Database Systems, Pearson Education, 2nd Edition.

Reference Books:

1. Chhanda Ray and Ray, Distributed Database Systems, Pearson education India, 2009.
2. Saeed K.Rahimi and Frank S.Haug, Distributed Database Management System - A Practical Approach, Wiley Publisher, 2010.

Online Resources:

1. <http://pcbunn.cithec.caltech.edu/DistributedDatabasesPakistan.pdf>
2. <http://web.cs.wpi.edu/~cs561/s12/LectureHours/45/DistributedDBs.pdf>

Course Outcomes:

After completion of the course, students will be able to

1. Design a database using ER diagrams.
2. Impose constraints over the data.
3. Create active databases and design assertions and triggers.
4. Differentiate key concepts and techniques for centralized databases and distributed databases.
5. Able to distribute the data among various sites and write query over the data.
6. Implement the concepts of deadlocks management.

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SANSKRIT FOR TECHNICAL KNOWLEDGE
(Audit Course-2)

Prerequisites: -

Course Objectives:

1. To get a working knowledge in Illustrious SANSKRIT, the scientific language in the world.
2. To improve brain functioning.
3. To enhance the memory power to develop logic in Mathematics, Science and other subjects.
4. To explore the huge treasure of knowledge that is hidden in the ancient literature.

UNIT 1: (~ 6 Lecture Hours)

Alphabets in SANSKRIT

Varnamala – Vowels (Swaraaha) and consonants (Vyanjanaani) – samyuktavarnaaha (compound letters) – Varna vishleshanam (Disjoining of letters) – Varna samshleshanam (Joining of letters) – Practise of simple words – Three genders – Pumlingam (Masculine Gender) – Streelingam (Feminine Gender) – Napumsaka lingam (Neutral Gender) – The forms of Nouns – Singular & Plural

UNIT 2: (~ 6 Lecture Hours)

Pronouns & Demonstrative pronouns (Sarvanaamashabdaaha) Eshaha, Yeshaa & Yetat – Question words – Five Ws & one H (Kim, kadaa, kutra, Kaha, Kimartham&Katham) Different forms of verbs – Tenses – Present – Past & Future Tenses.

UNIT 3: (~ 6 Lecture Hours)

Propositions (Vibhaktis) – Prathama – Dwitiya – Truteeya – Chaturthee – Panchami – Shashtee – Saptami – Sambodhana Prathama - The Three Purushas – Prathama (RamahaRaamouRaamaaha) – Madhyama (twamYuvaamYooyam) – Uttama(AhamAawaamVayam).

UNIT 4: (~ 6 Lecture Hours)

Order (Subject – Verb – Object) karta – Kriya – karma.

Introduction of Roots – Ancient literature on Science & Technology in SANSKRIT language - Scope of SANSKRIT in India – Technical information about SANSKRIT Literature. Technical concepts of Engineering.

UNIT 5: (~ 6 Lecture Hours)

Technical concepts of Engineering – Electrical, Mechanical, Architecture and Mathematics - Role of SANSKRIT in the field of Science & Technology. Scope of SANSKRIT as a powerful & alternative tool in the field of Computer Science.

Text Reading:

1. “ABHYAAS PUSTAKAM”, Dr. Vishwas, SamskruthaBharati Publications, New Delhi.
2. Teach Yourself SANSKRIT, Prathama Deeksha by VempatiKutumbaShastri, Rashtriya Sanskrit Sansthan, NewDelhi Publications.
3. “India’s glorious Scientific Tradition”, Suresh Soni, Ocean Books Pvt. Ltd., NewDelhi.

Online Resources:

1. NPTEL: https://onlinecourses.nptel.ac.in/noc18_hs35/preview

Course Outcomes:

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

1. Gain knowledge in basic SANSKRIT language.
2. Understand the ancient SANSKRIT literature about Science & Technology.
3. Develop logical and analytical skills.

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VALUE EDUCATION
(Audit Course-2)

Prerequisites: -

Course Objectives:

Students will be able to

1. Understand value of Education and self-development.
2. Imbibe good values in students.
3. Know the importance of character.

UNIT 1: (~ 7 Lecture Hours)

Values and self – development – Social values and Individual attitudes. Work ethics, Indian vision of humanism - Moral and non – moral Valuation - Standards and principles - Value judgements - Importance of cultivation of values.

UNIT 2: (~ 6 Lecture Hours)

Sense of duty, Devotion, Self – reliance. Confidence, Concentration, Truthfulness, Cleanliness - Honesty, Humanity. Power of faith, National Unity - Patriotism, Love for nature, Discipline

UNIT 3: (~ 6 Lecture Hours)

Personality and Behaviour Development – Soul and Scientific attitude. Positive thinking. Integrity and Discipline - Punctuality, Love and Kindness - Avoid Fault Thinking - Free from anger, Dignity of labour

UNIT 4: (~ 6 Lecture Hours)

Universal brotherhood and religious tolerance - True friendship - Happiness Vs suffering, love for truth - Aware of self - destructive habits - Association and Cooperation - Doing best for saving nature.

UNIT 5: (~ 6 Lecture Hours)

Character and Competence – Holy books Vs Blind faith - Self-management and Good Health - Science of Reincarnation - Equality, Nonviolence, Humility, Role of Women - All religions and same message - Mind your Mind, Self- control - Honesty, Studying effectively.

Text Reading:

1. Chakroborty, SK. 'Values and Ethics for Organizations – Theory and Practise', - Oxford University Press, NewDelhi.

Online Resources:

1. <http://nptel.ac.in/courses/109104068/36>
2. <http://nptel.ac.in/courses/109104068/37>

Course Outcomes:

After completion of the course the student will be able to

1. Gain knowledge on self-development.
2. Learn the importance of Human Values.
3. Develop overall personality.

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CONSTITUTION OF INDIA
(Audit Course-2)

Prerequisites: -

Course Objectives:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. Address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT 1: (~ 8 Lecture Hours)

History of making of the Indian Constitution & Philosophy of the Indian Constitution

History of making of the Indian Constitution: History, Drafting Committee (Composition & Working).

Philosophy of the Indian Constitution: Preamble, Salient Features.

UNIT 2: (~ 6 Lecture Hours)

Contours of Constitutional Rights and Duties

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT 3: (~ 6 Lecture Hours)

Organs of Governance:

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions- Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT 4: (~ 6 Lecture Hours)

Local Administration

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Panchayati Raj: Introduction, PRI: ZilaPanchayat, Elected

officials and their roles, CEO ZilaPanchayat: Position and role, Block Level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT 5: (~ 6 Lecture Hours)

Election Commission

Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr.S.N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edition, Lexis Nexis, 2014.

Online Resources:

1. <http://www.nptel.ac.in/courses/103107084/Script.pdf>

Course Outcomes:

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

1. Get the clarity and idea about function of Indian constitution.
2. Understand the Rights of equality, the Right of freedom and the Right to constitutional remedies
3. Grab the knowledge of union government & their powers and function.
4. Understand state and central policies, fundamental duties
5. Understand powers and functions of Municipalities, Panchayats and Co-operative Societies
6. Understand Electoral Process, special provisions

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I Year M.Tech. CSE II-Semester

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STRESS MANAGEMENT BY YOGA
(Audit Course-2)

Prerequisites: -

Course Objectives:

1. Creating awareness about different types of Stress and role of Yoga in the management of Stress.
2. Promotion of positive health and overall wellbeing (Physical, mental, emotional, social and spiritual).
3. Prevention of stress related health problems by Yoga practice.

UNIT 1: (~ 4 Lecture Hours)

Meaning and definition of Yoga - Historical perspective of Yoga - Principles of Astanga Yoga by Patanjali.

UNIT 2: (~ 4 Lecture Hours)

Meaning and definition of Stress - Types of Stress - Eustress and Distress - Anticipatory Anxiety and Intense Anxiety and depression - Meaning of Management- Stress Management.

UNIT 3: (~ 8 Lecture Hours)

Concept of Stress according to Yoga - Stress assessment methods - Role of Asana, Pranayama and Meditation in the management of stress.

UNIT 4: (~ 10 Lecture Hours)

Asanas: (5 Asanas in each posture) - Warm up - Standing Asanas - Sitting Asanas - Prone Asanas - Supine asanas - Surya Namaskar

UNIT 5: (~ 10 Lecture Hours)

Pranayama:Anulom and Vilom Pranayama - Nadishudhi Pranayama - Kapalabhati Pranayama - Bhramari Pranayama - Nadanusandhana Pranayama.

Meditation techniques: Om Meditation - Cyclic meditation : Instant Relaxation technique (QRT), Quick Relaxation Technique (QRT), Deep Relaxation Technique (DRT)

Reference Books:

1. Andrews, Linda Washer (2005) Stress control for peace of mind, London: Greenwich Editions.
2. Author's Guide -Yoga- The science of Holistic Living, Chennai: The Vivekananda Kendra Prakashan trust.
3. Iyengar BKS (2003) The art of Yoga, New Delhi: Harper Collins Publishers.
4. Lalvani, Vimla ((1998) Yoga for Stress, London: Hamlyn.
5. Maguire, Imelda (2005) Yoga for a healthy body, London: Greenwich editions.
6. Nagendra H.R. and Nagaratna.R (2004) Yoga prespective in stress management, Bangalore: Swami Vivekananda Yoga prakashan.
7. Nagendra H.R. and Nagaratna.R (2004) Yoga practices for Anxiety and Depression, Bangalore: Swami Sukhabhogananda Yoga prakashan.
8. Sukhabhogananda, Swami (2002) Stress management, Bangalore: Prakashan trust.
9. Udupa (1998) Stress management by Yoga , New Delhi: MotilalBandaridas Publishers pvt. Ltd.
10. Ravi Shankar N.S. (2001) Yoga for Health, New Delhi: Pustak Mahal.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc16_ge04/preview
2. <https://freevidelectures.com/course/3539/indian-philosophy/11>

Course Outcomes:

After completion of the course the student will be able to

1. Enhance of Physical strength and flexibility.
2. Learn to relax and focus.
3. Relieve physical and mental tension
4. Improve work performance/ efficiency.

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COMPILER FOR HPC
(Program Specific Elective - 5)

Prerequisites: Computer Organization & Compiler Design.

Course Objectives:

1. The objective of this course is to introduce structure of high performance compilers.
2. Student will learn to design a compiler that run efficiently in terms of space and time.
3. Have knowledge of cache coherence and parallel loops in modern compilers.

UNIT 1: (~ 9 Lecture Hours)

High Performance Systems, Structure of a Compiler, Programming Language Features, Languages for High Performance.

Data Dependence: Data Dependence in Loops, Data Dependence in Conditionals, Data Dependence in Parallel Loops, Program Dependence Graph. Scalar Analysis with Factored.

UNIT 2: (~ 8 Lecture Hours)

Use-Def Chains: Constructing Factored Use-Def Chains, FUD Chains for Arrays, Induction Variables Using FUD Chains, Constant Propagation with FUD Chains, Data Dependence for Scalars, Data Dependence Analysis for Arrays. Array Region Analysis, Pointer Analysis, I/O Dependence, Procedure Calls, Inter-procedural Analysis.

UNIT 3: (~ 14 Lecture Hours)

Loop Restructuring: Simple Transformations, Loop Fusion, Loop Fission, Loop Reversal, Loop Interchanging, Loop Skewing, Linear Loop Transformations, Strip-Mining, Loop Tiling, Other Loop Transformations, and Inter-procedural Transformations.

Optimizing for Locality: Single Reference to Each Array, Multiple References, General Tiling, Fission and Fusion for Locality.

Concurrency Analysis: Concurrency from Sequential Loops, Concurrency from Parallel Loops, Nested Loops, Round off Error, Exceptions and Debuggers.

UNIT 4: (~ 10 Lecture Hours)

Vector Analysis: Vector Code, Vector Code from Sequential Loops, Vector Code from For all Loops, Nested Loops, Round off Error, Exceptions and Debuggers, Multi-vector Computers.

Message-Passing Machines: SIMD Machines, MIMD Machines, Data Layout, Parallel Code for Array Assignment, Remote Data Access, Automatic Data Layout, Multiple Array Assignments, Other Topics.

UNIT 5: (~ 7 Lecture Hours)

Scalable Shared-Memory Machines: Global Cache Coherence, Local Cache Coherence, Latency Tolerant Machines.

Recent trends in compiler design for high performance computing and message passing machines and scalable shared memory machine.

Text Book:

1. Michael Wolfe, High-Performance Compilers for Parallel Computing, Pearson, 1995.

Online Resources:

1. www.springer.com/gp/book/9783540280095
2. www.chpc.utah.edu/documentation/software/compilers.php

Course Outcomes:

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

1. Understand the structure and working principle of compilers.
2. Handle exceptions and debugging in compilers.
3. Analyze data dependencies across various different data structures.
4. Design global optimizing techniques.
5. Use different message passing mechanisms.
6. Apply the concepts of scalable shared memory in designing compilers for high performance computing.

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OPTIMIZATION TECHNIQUES

(Program Specific Elective - 5)

Prerequisites: -

Course Objectives:

1. The objective of the course is to provide insight to the mathematical formulation of real world problems.
2. Optimize the mathematical problems using nature based algorithms. And the solution is useful especially for NP-Hard problems.

UNIT 1: (~ 8 Lecture Hours)

Engineering application of Optimization, Formulation of design problems as mathematical programming problems.

UNIT 2: (~ 8 Lecture Hours)

General Structure of Optimization Algorithms, Constraints, The Feasible Region.

UNIT 3: (~ 11 Lecture Hours)

Branches of Mathematical Programming: Optimization using calculus, Graphical Optimization, Linear Programming, Quadratic Programming, Integer Programming, Semi Definite Programming.

UNIT 4: (~ 12 Lecture Hours)

Optimization Algorithms like Genetic Optimization, Particle Swarm Optimization, Ant Colony Optimization etc.

UNIT 5: (~ 7 Lecture Hours)

Real life Problems and their mathematical formulation as standard programming problems. Recent trends and Applications of ant colony optimization.

Text Books:

1. Laurence A, Wolsey. Integer programming. Wiley. ISBN 978-0-471-28366-9, 1998.
2. Andreas Antoniou, Practical Optimization Algorithms and Engineering Applications.
3. Edwin K., P. Chong and Stanislaw h. Zak., An Introduction to Optimization.

Reference Books:

1. Dimitris Bertsimas and Robert Weismantel, Optimization over integers. Dynamic Ideas, 2005.
2. John K. Karlof, Integer programming: theory and practice. CRC Press. ISBN 978-0-8493-1914-3, 2006.
3. H. Paul Williams, Logic and Integer Programming. Springer. ISBN 978-0-387-92279-9.
4. Michael Jünger, Thomas M. Liebling; Denis Naddef; George Nemhauser; William R. Pulleyblank, Gerhard Reinelt; Giovanni Rinaldi and Laurence A. Wolsey, eds, 50 Years of Integer Programming 1958-2008: From the Early Years to the State-of-the- Art. Springer. ISBN 978-3-540-68274-5, 2009.
5. Der-San Chen; Robert G. Batson and Yu Dang, Applied Integer Programming: Modeling and Solution. John Wiley and Sons. ISBN 978-0-470-37306-4, 2010.

Online Resources:

1. www.kdd.org/kdd2016/topics/view/optimization-techniques
2. <https://www.springer.com/cda/content/document/cda.../9783642378454-c2.pdf>

Course Outcomes:

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

1. Formulate optimization problems.
2. Understand and apply the concept of optimality criteria for various types of optimization problems.
3. Solve various constrained in Single variable as well as multivariable.
4. Analyze the various unconstrained problems in Single variable as well as multivariable.
5. Comprehend and design a new mathematical system with the features that support real life problems.
6. Apply the methods of optimization in real life situation.

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BIG DATA ANALYTICS
(Program Specific Elective - 5)

Prerequisites: Data Structures & Computer Organization.

Course Objectives:

1. Understand big data for business intelligence.
2. Learn business case studies for big data analytics.
3. Understand NoSQL big data management.
4. Understand map-reduce analytics using Hadoop and related tools.

UNIT 1: (~ 9 Lecture Hours)

What is Big Data, Why Big Data: Convergence of Key Trends, Unstructured Data.

Industry Examples of Big Data: Web Analytics, Big Data and Marketing, Fraud and Big Data, Risk and Big Data, Credit Risk Management, Big Data and Algorithmic Trading, Big Data and Healthcare, Big Data in Medicine, Advertising and Big Data.

Big Data Technologies: Introduction to Hadoop, Open Source Technologies, Cloud and Big Data, Mobile Business Intelligence, Crowd Sourcing Analytics, Inter and Trans Firewall Analytics.

UNIT 2: (~ 8 Lecture Hours)

NoSQL: Introduction to NoSQL, Aggregate Data Models, Aggregates, Key-Value and Document Data Models, Relationships, Graph Databases, Schemaless Databases, Materialized Views.

Distribution Models: Sharding, Master-Slave Replication, Peer-Peer Replication, Sharding and Replication, Consistency, Relaxing Consistency, Version Stamps.

UNIT 3: (~ 10 Lecture Hours)

MapReduce: Partitioning and Combining, Composing Map-Reduce Calculations, Data Format, Analyzing Data with Hadoop, Scaling Out, Hadoop Streaming, Hadoop Pipes.

Hadoop Distributed File System: Design of Hadoop Distributed File System (HDFS), HDFS Concepts, Java Interface, Data Flow.

Hadoop I/O: Data Integrity, Compression, Serialization, Avro, File-Based Data Structures.

UNIT 4: (~ 9 Lecture Hours)

Developing A MapReduce Application: MapReduce Workflows, 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: Input Formats, Output Formats.

UNIT 5: (~ 9 Lecture Hours)

Hbase: Data Model and Implementations, Hbase Clients, Hbase Examples, Praxis.

Hive: Comparison with Traditional Databases, HiveQL, Tables, Querying Data, User Defined Functions.

Pig: Grunt, Comparison with Databases, Pig Latin, User Defined Functions, Data Processing Operators.

Text Books:

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics" , John Wiley & Sons, Inc.2013.
2. P.J Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
3. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.

Reference Books:

1. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
2. Lars George "HBase: The Definitive Guide" , O'Reilley, 2011.
3. Alan Gates, "Programming Pig", O'Reilley, 2011.
4. 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

Course Outcomes:

After completion of the course, students will be able to

1. Describe big data and use cases from selected business domains.
2. Understand NoSQL big data management and various distribution models.
3. Understand the design of HDFS and Hadoop I/O.
4. Understand map-reduce analytics using Hadoop.
5. Understand Hadoop related database tools such as HBase and Hive.
6. Write Pig Scripts for Big Data Analytics.

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BUSINESS ANALYTICS

(Open Elective-1)

Prerequisites: -

Course Objectives:

1. To understand the role of business analytics within an organization.
2. To gain an understanding in usage of business analytics in formulating and solving problems using analytical and management tools in managerial decision making.
3. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization and across various sectors.

UNIT 1: (~ 9 Lecture Hours)

Introduction to Business Analytics

Introduction to Business Analytics: Overview of Business Analytics, Evolution of Business Analytics, classification of Business Analytics, Trends of Business Analytics, frame work of Business Analytics, Data for Business Analytics, Decision models, Problem solving & decision making. Business analytics process and organization. Competitive and advantages.

UNIT 2: (~ 8 Lecture Hours)

Statistics for Business Analytics

Organization structure of Business Analytics: Team management issues, designing information policy, outsourcing, ensuring data quality, Introduction to Data mining Descriptive Analytic tools – Statistical notation. Data Summarization methods.

UNIT 3: (~ 9 Lecture Hours)

Descriptive Tools

Descriptive Statistical Tools – Tables, graphs, charts, histograms, frequency distribution, relative frequency. Measures of central tendency & dispersion. Introduction to Probability theory & distributions (Binomial, Poisson & Normal) Sampling & estimation methods.

UNIT 4: (~ 10 Lecture Hours)

Forecasting Techniques

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting models, Forecasting Models for stationary Time series. Forecasting Models for Time series with a linear trend, Forecasting Time

series for seasonality, Regression Forecasting with casual variables, selecting Appropriate Forecasting Models. Monte Carlo simulation and Risk Analysis: Monte Carlo simulation using Analytic solver platform, Newsvendor Model, Overbooking Model.

UNIT 5: (~ 12 Lecture Hours)

Decision Analysis

Decision Analysis: Formulating Decision problems, Decision strategies, Decision trees, value of information utility & decision making, data story telling & Data Journalism, Recent Trends in: Embedded & collaborative business intelligence. Data warehousing & Data mining.

Text Books:

1. Gert H. N. Laursen, Jesper Thorlund, Business Analytics for Managers: Taking Business Intelligence Beyond Reporting, Publication, Wiley Publication, 2nd Edition.
2. Al Bright/Winston, Business Analytics: Data Analysis & Decision Making, Cengage Learning Publication, 5th Edition.

Reference Books:

1. Marc I. Schniederjans, Dara G. Schniederjans, Christopher M. Sarkey, Business analytics Principles, Concepts, and Applications, Pearson FT Press, 1st Edition.
2. James Evans, Business Analytics, Pearsons Education, 2nd Edition.

Online Resources:

1. NPTEL: Business Analytics for Management Decision
2. <http://nptel.ac.in/courses/110105089/>

Course Outcomes:

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

1. Have a knowledge of data analytics.
2. Think critically in making decisions based on data analytics.
3. Identify the befitting descriptive tool required for the business problem.
4. Identify appropriate prescriptive modeling technique for decision making.
5. Apply suitable predicative method that supports business decision making.
6. Translate data into clear, actionable insights in the decision making process.

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INDUSTRIAL SAFETY

(Open Elective-1)

Prerequisites: -

Course Objectives:

The purpose of this course is to teach the students.

1. Concepts of industrial safety and provide useful knowledge for work place safety.
2. Helps in identification, evaluation and control of the hazards.
3. Mitigate harm to people, property and the environment.

Unit 1: (~ 10 Lecture Hours)

Industrial safety - Importance and objectives of safety, safety programs – components and realisation. Evolution of modern safety concept, safety policy, safety organisation. implementation of safety procedures - periodic inspection and replacement.

Unit 2: (~ 8 Lecture Hours)

Accidents causes, types, results and control, mechanical and electrical hazards types, causes and preventive steps, describe salient points and factories act 1948 for health and safety, wash rooms, drinking water layout, lights, cleanliness fire guarding etc., safety colour code, fire prevention and fire fighting equipments and methods.

Unit 3: (~ 10 Lecture Hours)

Fundamentals of maintenance engineering, Definition aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, types of maintenance, types of applications of tools used for maintenance, maintenance cost and its relations with replacement economy, service life of equipment.

Unit 4: (~ 9 Lecture Hours)

Quality and safety in maintenance: needs for quality maintenance process, maintenance work quality, use of quality control, charts in maintenance work sampling, post maintenance testing, reasons for safety problems in maintenance, guidelines to safety in maintenance work, safety officers' role in maintenance work, Protection of maintenance workers.

Unit 5: (~8 Lecture Hours)

Periodic and preventive maintenance: Periodic inspection – concept and need, degreasing, cleaning and repairing schemes, over hauling of mechanical components, overhauling of electrical motors, common troubles

and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance.

Text Books:

1. 2. Krishnan N.N. Safety management in industries, Jaico publishing house, Bombay, 1997.
2. H.P. Garg, S., Maintenance Engineering, S. Chand and company.

References :

1. Handley, W. Industrial safety Hand book, 2nd Edition, McGraw-Hill Book Company, 1969.
2. Higgins & Morrow, Maintenance Engineering Handbook, Da Information Services.
3. Mc Cornick, E.J., Human Factors in Engineering and design, Tata McGraw-Hill, 1982.

Online websites/ Materials :

1. <https://www.spplimited.co.in/industrial-safety-certificate-course-training-in-chennai/>
2. https://onlinecourses.nptel.ac.in/noc18_mg42/preview

Course Outcomes:

Students after completing this course would be able to

1. Know the need for safety in industries
2. Know about factory acts and industrial safety regulations
3. Analyse causes and types of different hazards on their preventions
4. Asses quality maintenance processes and maintenance work quality
5. Assess safety practices and programs.
6. Know about periodic and preventive maintenance activities in industries.

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OPERATIONS RESEARCH
(Open Elective-1)

Prerequisites: -

Course objectives:

The course will enable the students to:

1. Study the linear programming and non linear programming techniques used for business and engineering applications.
2. Understand the importance of dynamic programming concept in operations research.
3. Know about the inventory, Game theory and waiting line model applications in real world.

UNIT 1: (~ 10 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.

Assignment Problem: Formulation. Hungarian method for optimal solution. Solving unbalanced Assignment problem.

UNIT 3: (~ 8 Lecture Hours)

Non-linear Programming: Introduction to non-linear programming (NLP), Convex and concave functions, NLP with one variable, Line search algorithms, Multivariable unconstrained problems, constrained problems, Lagrange Multiplier, The Karush-Kuhn-Tucker (KKT) conditions, the method of steepest ascent, convex combination method, penalty function, Quadratic programming.

UNIT 4: (~ 8 Lecture Hours)

a) **Dynamic programming:** Characteristics of dynamic programming. Dynamic programming approach for Coach / Shortest Path and cargo loading problems.

b) **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: (~ 10 Lecture Hours)

a) **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.

b) **Waiting lines:** Single channel –poisson arrivals and exponential service times with infinite population and finite population models. Multi channel-poisson arrivals and exponential service times with infinite population

Text Books:

1. J K Sharma., Operations Research, theory and applications, 5th Edition, Macmillan India Ltd ,2013
2. S S Rao, Engineering optimisation – Theory and Practice, 4th Edition, John Wiley & Sons Inc., 2009 .

Reference Books:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. F.H. Hillier and G.J. Lieberman, Introduction to Operations Research, Tata-McGraw-Hill, 2010
3. S.D. Sharma, Operations Research, Kedarnath, Ramnath& Co., Meerut, 2009.
4. V.K. Kapoor, Operations Research”, S. Chand Publishers, New Delhi, 2004.

Online Resources:

1. IOR Tutorials (Interactive Operations Research)

Course outcomes

At the end of the course students are expected to

- 1 Apply linear programming models to several Engineering Applications.
- 2 Able to apply the concept of non linear programming.
- 3 In Dynamic Programming selected models were taught.
- 4 Apply simple mathematical models in Inventory into the real Engineering Applications.
- 5 Solve Game theory problems related to business applications.
- 6 To minimize waiting time of the customer and optimization of number of servers.

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COST MANAGEMENT OF ENGINEERING PROJECTS
(Open Elective-1)

Prerequisites: -

Course Objectives:

1. Give inputs in handling the cost associated with engineering projects.
2. Acquaint the practical aspects of cost management.
3. Orient the quantitative techniques applicable to cost management.

UNIT 1: (~ 10 Lecture Hours)

Cost Management - Introduction and importance of Cost Management, Cost Classification on the basis of behaviour (as variable, fixed and semi variable), traceability (as direct and indirect), functions (as production cost, administration cost, selling cost and distribution cost), Various cost concepts. Objectives of costing system, Traditional Costing system, Activity Based Costing (ABC), and Cost Audit.

UNIT 2: (~ 7 Lecture Hours)

Project Management – Project Planning, Types of Project, Stages of Project execution importance of PERT and CPM, Project crashing – Problems.

UNIT 3: (~ 10 Lecture Hours)

Budgetary Control – Introduction to Budget, Concepts advantages, types of Functional budgets: Fixed and Flexible budget, Performance budget, Cash Budget and Production Budget. Introduction to Zero based budgeting, (Simple Problems on Functional based budget).

UNIT 4: (~ 10 Lecture Hours)

Inventory Management - Valuing the Inventory using LIFO, FIFO and Weighted Average Methods, Economic Order Quantity (EOQ), Just-in-time, Material Requirements Planning (MRP), ABC Analysis, VED Analysis and Value Chain Analysis.

UNIT 5: (~ 10 Lecture Hours)

Costing for Managerial Decision Making - Factors governing pricing policy, objectives of Pricing policy, concept of transfer pricing, objectives and methods. Choosing the right Pricing method with simple problems. International Transfer Pricing. Relevant costing for make or buy and evaluation of special order.

Text Books:

1. Charles T. Horngren and George Foster, Cost Accounting: A Managerial Emphasis, PHI, 1st Edition.
2. Anthony A. Atkinson, Robert S. Kalpan et al., Management Accounting, Pearson, 6th Edition.
3. N. D. Vohra, Quantitative Techniques in Management, Tata Mc. Graw Hill, 4th Edition.

Reference Books:

1. Blocher, Chen, Cokins, and Lin, Cost Management: A Strategic Emphasis.
2. John K. Shank and Vijay Govindarajan, Strategic Cost Management.

Online Resources:

1. Managerial Accounting: <http://nptel.ac.in/courses/110101004/24>

Course Outcomes:

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

1. Perceive the cost associated in managing engineering projects
2. Prepare budgets for engineering projects.
3. Enumerate and effectively handle the inventory management in reducing the project management cost.
4. Envelope the cost associated in price fixation of the projects.
5. Orient the cost management decision-making using quantitative methodology in minimizing the cost associated with the projects.
6. Furnish effective cost management practices for better handling of engineering projects

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COMPOSITE MATERIALS
(Open Elective-1)

Prerequisites: -

Course Objectives:

1. Learn to demonstrate a critical understanding of composite materials of their nature and application
2. Critically evaluate the types of reinforcements and their advantages in application.
3. Develop an understanding of different types of metal matrix composites and their preparation.
4. Develop an understanding of different types of ceramic matrix composites and their preparation.
5. Develop an understanding of different types of polymer matrix composites and their preparation.
6. Critically evaluate strength of the composite materials through Laminar study.

UNIT 1: (~ 9 Lecture Hours)

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT 2: (~ 9 Lecture Hours)

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT 3: (~ 9 Lecture Hours)

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT 4: (~ 8 Lecture Hours)

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT 5: (~ 9 Lecture Hours)

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygro-thermal failure. Laminate first ply failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Text Books:

1. R.W.Cahn, Material Science and Technology – Vol 13 – Composites, VCH, West Germany.
2. WD Callister, Jr., Adapted by R.Balasubramaniam, Materials Science and Engineering, An introduction, John Wiley & Sons, NY, Indian Edition, 2007.

Reference Books:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W.

Online Resources:

1. http://nptel.ac.in/courses/Webcourse-contents/IISc-BANG/Composite%20Materials/pdf/Lecture_Notes/LNm1.pdf
2. https://www.asminternational.org/documents/10192/1849770/05287G_Sample_Chapter.pdf
3. http://home.iitk.ac.in/~mohite/Composite_introduction.pdf
4. https://onlinecourses.nptel.ac.in/noc18_me03/preview
5. <https://www.online.colostate.edu/courses/MECH/MECH530.dot>

Course Outcomes:

After completion of the course students will be able to

1. Learn different composite materials and their applications
2. Have capacity to integrate knowledge and to analyse, evaluate and manage the different the types of reinforcements.
3. Develop different types of metal matrix composites and prepare the same for their specific needs as engineers.
4. Develop different types of ceramic matrix composites and prepare the same for their specific needs as engineers.
5. Develop different types of polymer matrix composites and prepare the same for their specific needs as engineers.
6. Critically enhance strength of the composite materials through Laminar usage.

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ENERGY FROM WASTE
(Open Elective-1)

Prerequisites: -

Course Objectives:

1. To classify various waste resources.
2. To identify various methods of waste disposal.
3. To study various energy generation methods from waste.
4. To analyze various processes of recycling of waste and environmental benefits.
5. To know the significance of managing of waste.

Unit 1: (~ 8 Lecture Hours)

Introduction: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW, recycling of municipal waste , Segregation of waste , Managing waste , Medical waste /Pharmaceutical waste treatment , Environmental impacts. Solid waste: Land fill method of Solid waste disposal, Land fill classification, Types.

Unit 2: (~ 10 Lecture Hours)

Biomass: Pyrolysis – Types, Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications. Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit 3: (~ 8 Lecture Hours)

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit 4: (~ 10 Lecture Hours)

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes. Types of biogas Plants – Applications - Alcohol production from

biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Unit 5: (~ 8 Lecture Hours)

E-waste: e-waste in the global context- Environmental concerns and health hazards Recycling e-waste, Global trade in hazardous waste, e-waste legislation, Government regulations on e-waste management.

Text Books:

1. Desai, Ashok V., "Non Conventional Energy" Wiley Eastern Ltd., 1990.
2. Khandelwal, K.C. and Mahdi S.S. "Biogas Technology-A Practical Hand Book Vol.I& II," Tata McGraw Hill Publishing Co.Ltd.' 1983.
3. Challal,D.S., " Food, Feed and Fuel from Biomass" IBH Publishing Co.Pvt.Ltd.,1991.
4. Nicholas P.Cheremisinoff."Handbook of Solid Waste Management and Waste Minimization Technologies" An Imprint of Elsevier, New Delhi , 2003.

Reference Books:

1. C.Y.WereKo-Brobby and E.B.Hagan," Biomass Conversion and Technology" John Wiley & Sons,1996.
2. M.Dutta,B.P.Parida,B.K.Guha and T.R.Surkrishnan " Industrial Solid Waste Management and Landfilling practice."Narosa Publishing House, New Delhi, 1999.
3. P.AarneVesilind,WilliamA.Worrell and Debra R.Reinhart, " Solid Waste Engineering" Thomson Asia Pte Ltd. Singapore (2002)

Course Outcomes:

Upon the completion of the subject, the student will be able to

1. Understand the methods of recycling of waste.
2. Compare the methods of waste disposal.
3. Identify different sources of energy from waste.
4. Analyze methods for management of waste.
5. Understand the global trade in hazardous waste.
6. Utilize different sources of energy from waste in an efficient and economical way for practical utilities.

G. NARAYANAMMA INSTITUTE OF TECHNOLOGY & SCIENCE
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II Year M.Tech. I-Semester

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POWER FROM RENEWABLE ENERGY SOURCES
(Open Elective-1)

Prerequisites: -

Course Objectives:

1. To introduce various types of renewable energy technologies
2. To understand the technologies of energy conversion from the resources and their quantitative analysis

UNIT 1: (~ 10 Lecture Hours)

Fundamentals of Solar Energy-Solar spectrum- Solar Radiation on Earth's surface - Solar radiation geometry - Solar radiation measurements - Solar radiation data - Solar radiation on horizontal and tilted surfaces. Solar Thermal conversion- Flat plate collectors- concentrated collectors- construction and thermal analysis- Solar applications - Solar ponds - Heliostat systems-water heater - air heater-solar still

UNIT 2: (~ 8 Lecture Hours)

Solar-Electric Power generation- Photovoltaic cells - Equivalent circuit- V-I Characteristics - Photovoltaic modules - constructional details- design considerations - Tracking- Maximum power point tracking - Solar Thermo electric conversion.

UNIT 3: (~ 8 Lecture Hours)

Wind Energy- Fundamentals of wind energy-power available in wind- Betz Limit Aerodynamics of wind turbine- Wind turbines- Horizontal and vertical axis turbines -their configurations- Wind Energy conversion systems

UNIT 4: (~ 9 Lecture Hours)

Energy from Bio Mass- Various fuels- Sources-Conversion technologies-Wet Processes - Dry Processes- Bio Gas generation - Aerobic and anaerobic digestion - Factors affecting generation of bio gas - Classification of bio gas plants-Different Indian digesters- Digester design considerations - Gasification process - Gasifiers - Applications. Geothermal Energy - sources- Hydrothermal convective - Geo-pressure resources - Petro-thermal systems (HDR) - Magma Resources-Prime Movers.

UNIT 5: (~ 9 Lecture Hours)

Ocean Thermal Energy Conversion Systems- Principle of operation - Open and closed cycles, Energy from Tides - Principle of Tidal Power - Components of tidal Power plants - Operation Methods - Estimation of Energy in Single and double basin systems - Energy and Power from Waves Wave energy conversion devices - Fuel Cells - Design and Principle of operation - Types of Fuel Cells - Types of Electrodes – Applications - Basics of Batteries - Constructional details of Lead acid batteries - Ni-Cd Batteries.

Text Books:

1. “John Twidell & Wier”, “Renewable Energy Resources”, CRC Press, 2009
2. “G. D. Rai”, “Non Conventional Energy sources”, Khanna publishers, 2004

Reference Books:

1. “D. P .Kothari, Singal, Rakesh and Ranjan”, “Renewable Energy sources and Emerging Technologies”, PHI, 2009.
2. “F. C. Treble”, Generating Electricity from Sun, Pergamon Press, 1st Edition 1991
3. “C. S. Solanki”, “Solar Photovoltaics - Fundamentals- Principles and Applications”, PHI, 2009
4. “S. P. Sukhatme”, “Solar Energy Principles and Application”, TMH, 2009.

Course Outcomes:

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

1. Analyse solar thermal and photovoltaic systems and related technologies for energy conversion
2. Understand Wind energy conversion and devices available for it
3. Understand Biomass conversion technologies, Geo thermal resources and energy conversion principles and technologies
4. Realize Power from oceans (thermal, wave, tidal) and conversion devices
5. Understand fundamentals of fuel cells and commercial batteries.
6. Suggest suitable method of power generation for a particular region/ organization based on the availability of resources.