ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS

M.TECH

COMPUTER NETWORKS AND INFORMATION SECURITY

(CNIS)

(APPLICABLE FOR THE BATCHES ADMITTED FROM 2018-2019)

G. Narayanamma Institute of Technology & Science (for Women)
(Autonomous)
Shaikpet, Hyderabad - 500 104, Telangana State

ACADEMIC REGULATIONS 2018

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

(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 :

S.No.	*Branch/ Department*	*Specialization*
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 ($\geq$ 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** (**L**ecture Periods: **T**utorial Periods: **P**racticals Periods : **C**redits) Structure, based on the following general pattern:

- One Credit - for One hour/ Week/ Semester for Theory/ Lecture (L) Courses, and Tutorials (T); and,
- One Credit - for Two hours/ Week/ Semester for Laboratory/ Practical (P) Courses.
- Student activity courses like NCC, NSS, NSO, and other Courses identified as 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 AITCTE 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 (E&C)**	**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 , totaling 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/Counselor 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), 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 (ii) 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; 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.

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 (ie., 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 totaling 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, she 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 End Semester Examination (ESS) 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 25 Marks), and Assignment marks (for 5 marks).

b) During the semester, there shall be 2 Mid-Term examinations. Each Mid-Term examination shall be for 25 marks (with 120 minutes duration), and the question paper shall contain 5 questions (each for 5 marks) and all the 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 25 marks.

c) There shall be an allocation of 5 marks for the Assignments, and there shall be two Assignments. First Assignment shall be submitted before the conduct of the first Mid-Term examinations, and the Second Assignment shall be submitted before the conduct of the second Mid-Term examinations. The Assignments shall be as specified by the Subject Teacher concerned.

d) The first mid-term examination marks and the first Assignment marks combined together, shall make the first set of CIE marks, and the second mid-term examination marks and the second Assignment marks shall make the second set of CIE marks; and the AVERAGE of the two sets of mid-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 endof 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 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-sequent 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:

% of Marks Secured (Class Intervals)	*Letter Grade (UGC Guidelines)*	*Grade Poin (GP)*
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/ Seminar/ Comprehensive Viva-voce/Project.

Credit Points (CP) = Grade Points (GP) x Credits

11.7 The student passes the Subject/ Seminar/ Comprehensive Viva-voce/Project only when she gets GP ≥ 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:

SGPA = { $_1C_i$ } / { $_1C_i$ } …. For each semester,

where 'i' is the Subject indicator index (takes into account all Subjects in a Semester), 'N' is the no. of Subjects 'REGISTERED' for the Semester, is the no. of Credits allotted to the ith Subject, and represents the Grade Points (GP) corresponding to the Letter Grade awarded for that ith 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:

CGPA = { $_1C_j$ } / { $_1C_j$ } …. For all S Semesters registered

(ie., upto and inclusive of S semesters, S ≥ 2),

where 'M' is the TOTAL no. of Subjects (as specifically required and listed under the Course Structure of 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), is the no. of Credits allotted to the jth Subject, and represents the Grade Points (GP) corresponding to the Letter Grade awarded for that jth 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

% of Marks = CGPA x 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 $\geq$ 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) $\geq$ 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 $\geq$ 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 $\geq$ 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) $\geq$ 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) $\geq$ 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 into 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.	

COMPUTER NETWORKS & INFORMATION SECURITY

M.Tech. in Computer Networks and Information Security (CNIS)

2 Year (4 semesters) Regular Programme
COURSE STRUCTURE AND SYLLABUS

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

I YEAR **I SEMESTER**

Group	Subject	L	T	P	Credits
Program Core 1	Advanced Data Structures	3	-	-	3
Program Core 2	Mathematical Foundations of Cryptography	3	-	-	3
Program Specific Elective 1	1. Computer Networking 2. Network Programming 3. TCP/IP Internetworking	3	-	-	3
Program Specific Elective 2	1. Digital Forensics 2. Intrusion Detection 3. Information Theory & Coding	3	-	-	3
Laboratory 1	Advanced Data Structures Lab	-	-	4	2
Laboratory 2	Based on Program Specific Electives 1	-	-	4	2
PW	Research Methodology & IPR	2	-	-	2
Audit 1	Audit Course 1	2	-	-	0
	TOTAL	**16**	**0**	**8**	**18**

I YEAR **II SEMESTER**

Group	Subject	L	T	P	Credits
Program Core 3	Advanced Algorithms	3	-	-	3
Program Core 4	Cyber Security	3	-	-	3
Program Specific Elective 3	1. Cloud Computing 2. Storage Area Networks 3. Distributed Databases	3	-	-	3
Program Specific Elective 4	1. Ethical Hacking 2. Malware Analysis 3. Information Security	3	-	-	3
Laboratory 3	Advanced Algorithms Lab	-	-	4	2
Laboratory 4	Based on Program Specific Electives 4	-	-	4	2
	MINI PROJECT with Seminar	-	-	4	2
Audit 2	Audit Course 2	2	-	-	0
	TOTAL	**14**	**0**	**12**	**18**

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II YEAR **I SEMESTER**

Group	Subject	L	T	P	Credits
Program Specific Elective 5	1. Wireless Networks 2. Internet of Things 3. Network Security Standards and Applications Evaluation	3	-	-	3
Open Elective 1	Open Elective	3	-	-	3
Project	Project/ Dissertation Phase – 1	-	-	20	10
	TOTAL	**6**	**0**	**20**	**16**

II YEAR **II SEMESTER**

Group	Subject	L	T	P	Credits
Project	Project/ dissertation Phase - 2	-	-	32	16
	TOTAL	**0**	**0**	**32**	**16**

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List of Open Electives offered by various Departments

S.No.	Course Title	Offering Department
1.	Business Analytics	Humanities and Management
2.	Industrial Safety	Mechanical Engineering
3.	Operations Research	Mechanical Engineering
4.	Cost Management of Engineering Projects	Humanities and Management
5.	Composite Materials	Basic Sciences
6.	Energy from Waste	Electrical and Electronics Engineering
7.	Power from Renewable Energy Sources	Electrical and Electronics Engineering

List of Audit Courses offered by various Departments during I-Semester

S.No.	Course Title	Offering Department
1.	English for Research Paper Writing	Humanities and Management
2.	Disaster Management	Basic Sciences
3.	Pedagogy Studies	Humanities and Management
4.	Personality Development through Life Enlightenment Skills	Humanities and Management

List of Audit Courses offered by various Departments during II-Semester

S.No.	Course Title	Offering Department
1.	Sanskrit for Technical Knowledge	Humanities and Management
2.	Value Education	Humanities and Management
3.	Constitution of India	Humanities and Management
4.	Stress Management by Yoga	Humanities and Management

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I Year M.Tech. CNIS - I Sem **L T P C**
3 - - 3

ADVANCED DATA STRUCTURES
(Common to CNIS & CSE)

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, Quadtrees, 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_lectures_tutorials.php
4. https://www.coursera.org/

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. CNIS - I Sem **L T P C**
3 - - 3

MATHEMATICAL FOUNDATIONS OF CRYPTOGRAPHY

Prerequisites: Fundamental concepts of number theory

Course Objectives:
1. Build a solid mathematical basis to understand foundations of cryptography
2. Formally understand the notions related to security authentication and privacy.
3. Provide a rigorous treatment of the emerging and key subject subarea of CSE - Security.

UNIT 1: (~ 9 Lecture Hours**)**
Basic functions of cryptology - encryption, signature and identification problems. Mathematical basics - basics of computational number theory - elliptic curves - pairing functions.

UNIT 2: (~ 9 Lecture Hours**)**
Fundamental constructs –Distinguishability - pseudo-random number generator - one way functions with trapdoor. Some number theoretic candidates - RSA and discrete log variants.

UNIT 3: (~ 11 Lecture Hours**)**
Security models for encryption schemes - CPA, CCA1, CCA2 security. Secure hash functions - random oracle and standard models of proof techniques under various security models. RSA, El Gamal, Rabin and Cremar- Shoup encryption schemes.

UNIT 4: (~ 8 Lecture Hours**)**
Digital signatures - provably secure signature schemes - signcryption - ID-based and certificateless cryptology.

UNIT 5: (~ 8 Lecture Hours**)**
Identification schemes - zero knowledge protocols - perfect, statistical, and computational zero knowledge - applications to commitment schemes.

Text Books:
1. Oded Goldreich, Foundations of Cryptography (two volumes) Cambridge University Press, 2001, 2004 (Indian print available).

Reference Books:

1. J.Katz and Y.Lindell, Introduction to Modern Cryptography, Chapman Hall, USA 2007.
2. Wen Bo Mao, Modern Cryptography - Theory and practice, Prentice Hall, USA, 2003 (Indian edition available).

Online Resources:

1. http://cacr.uwaterloo.ca/hac/
2. http://people.cs.bris.ac.uk/~nigel/Crypto_Book//
3. https://www.coursera.org
4. https://www.udemy.com/cryptography/

Course Outcomes:

1. Demonstrate the formal foundations of cryptography.
2. Illustrate the basic mathematical principles and functions that form the foundation for cryptographic and cryptanalysis methods.
3. Identify strong pseudorandom generators for hashing and private-public key cryptosystems.
4. Explain and Analyse various security models for Encryption schemes.
5. Illustrate and Compare some standard digital signature schemes.
6. Explain the relevance of Zero knowledge protocol to cryptographic techniques.

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I Year M.Tech. CNIS - I Sem

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COMPUTER NETWORKING
(Program Specific Elective-1)

Prerequisites: Computer Programming and Data Structures

Course Objectives:
1. Understand network protocols, architectures and applications.
2. Analyse existing transport and network layer protocols.
3. Knowledge of mobile and wireless networks.
4. Understand the security issues and mechanism in the layered architecture.

UNIT 1: (~ 9 Lecture Hours**)**
Computer Networks and the Internet: Network Edge, Network Core, delay, loss, throughput in packet switched networks, Protocol layers and their service models, Networks under attack. Electronic Mail (SMTP, MIME, IMAP), World Wide Web (HTTP), Name Service (DNS), Network Management (SNMP), ATM.

UNIT 2: (~ 9 Lecture Hours**)**
Introduction and Transport-Layer Services,
Connectionless transport: UDP, Principles of reliable data transfer,
Connection oriented transport: TCP, Principles of Congestion Control.

UNIT 3: (~ 9 Lecture Hours**)**
The Network Layer: Introduction, **The Internet Protocol (IP):** Forwarding and addressing, **Routing algorithms:** Link-state, Distance vector, hierarchical routing algorithms, **Routing in the internet:** Intra AS routing (RIP, OSPF), Inter as Routing (BGP), Broadcast and multicast routing.

UNIT 4: (~ 9 Lecture Hours**)**
Wireless and Mobile Networks: Introduction, Wireless Links and Network Characteristics, Wi-Fi: 802.11 Wireless LANs, Cellular Internet Access
Mobility Management: Principles, Mobile IP, Managing Mobility in Cellular Networks and Impact on Higher-Layer Protocols.

UNIT 5: (~ 9 Lecture Hours**)**
Peer-to-Peer Networks, Content Distribution Networks, VOIP, Cryptographic Building Blocks, Pretty Good Privacy (PGP), Secure Shell (SSH), Transport

Layer Security(TLS, SSL, HTTPS), IP Security (IPsec),Wireless Security (802.11i)

Text Books:

1. James F. Kurose and Keith W.Ross, Computer Networking: A Top-Down Approach, 6/e, Pearson Education, 2012.
2. Larry L. Peterson and Bruce S. Davie, Computer Networks: A systems approach, Morgan Kaufman, 5th Edition, 2012

Reference Books:

1. Behrouz A. Forouzan, Data Communications and Networking, 4th Edition, Tata McGraw Hill.
2. Priscilla Oppenheimer, Top-Down Network Design, 2nd Edition, Pearson Education (CISCO Press)
3. Dayanand Ambawade, Dr. Deven shah and Prof. Mahendra Mehra, Advance Computer Network, Wiley India.
4. Nader F. Mir, Computer Communications Networks, Pearson Education.
5. Andrew S. Tanenbaum and David J. Wetherall, Computer Networks, Pearson, 5th Edition, 2014.

Online Resources:

1. https://www.cs.vu.nl/~ast/CN5/
2. https://www.ccri.edu/engt/website_network.html
3. Http://www.ece.rutgers.edu/~marsic/books/CN/links/
4. http://www.networkmagazineindia.com/200203/200203special.shtml
5. https://in.udacity.com
6. https://www.coursera.org

Course Outcomes:

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

1. Familiarity with the basic protocols of computer networks and how they can be used in network design and implementation.
2. Understand the various application layer protocols.
3. Explain the design issues in transport layer for the different applications and services requirements.
4. Specify the deficiencies in existing protocols and formulate better protocols.
5. Illustrate the issues in Mobile and Wireless Networks.
6. Have a basic knowledge of network security

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Department of Information Technology

I Year M.Tech. CNIS - I Sem **L T P C**
3 - - 3

NETWORK PROGRAMMING
(Program Specific Elective-1)

Prerequisites: Basic knowledge of programming and network fundamentals.

Course Objectives:
1. Student will understand Inter Process Communication.
2. Will perform Inter Process Communication among processes within a machine.
3. Will perform Inter Process Communication among processes on different machines connected through network.

UNIT 1: (~ 10 Lecture Hours**)**
Inter Process Communication: Introduction, File and record locking, Pipes, FIFOs streams and messages, Name spaces, system V IPC, Message queues, Semaphores.
Introduction to Network Programming: OSI model, Unix standards, TCP and UDP & TCP connection establishment and Format, Buffer sizes and limitation, standard internet services, Protocol usage by common internet application**.**

UNIT 2: (~ 10 Lecture Hours)
Sockets: Address structures, value, result arguments, Byte ordering manipulation, function and related functions **Elementary TCP sockets**, Socket, connect, bind, listen, accept, fork and exec function, concurrent servers. Close function and related functions.
TCP client server: Introduction, TCP Echo Server/Client functions, Normal startup, terminate and signal handling server process termination, Crashing and Rebooting of server host shutdown of server host.

UNIT 3: (~ 9 Lecture Hours)
I/O Multiplexing: I/O Models, select function, Batch input, shutdown function, poll function, TCP Echo server
Socket options: getsockopt and setsockopt functions. Socket states, Generic Socket option IPV6 socket option ICMPV6 socket option IPV6 socket option and TCP socket options.

UNIT 4: (~ 8 Lecture Hours)
Elementary UDP sockets: Introduction UDP Echo Server/Client function, Lost Datagrams, summary of UDP example, Lack of flow control with UDP, determining Outgoing Interface with UDP.
Elementary name and Address conversions: DNS, gethostbyName function, Resolver option, Function and IPV6 support, uname function, other networking information.

UNIT 5: (~8 Lecture Hours**)**
Daemon Processes and inetd Superserver , Introduction, syslogd Daemon, syslog Function, daemon_init Function, inetd Daemon, daemon_inetd Function **Broadcasting**- Introduction, Broadcast Addresses, Unicast versus Broadcast, dg_cli Function Using Broadcasting, Race Conditions.
Remote Login: Terminal line disciplines, Pseudo-Terminals, Terminal modes, Control Terminals, rlogin Overview, RPC Transparency Issues.

Text Books:
1. W.Richard Stevens, UNIX Network Programming, Vol. I, Sockets API, 2nd Edition. - Pearson Edn. Asia.
2. W.Richard Stevens, UNIX Network Programming, 1st Edition, - PHI.

Reference Books:
1. Graham GLASS and King Ables, UNIX for Programmers and Users, 3rd Edition Pearson Education
2. M. J. Rochkind, Advanced UNIX Programming 2nd Edition Pearson Education

Online Resources:
1. https://www.edx.org/school/uc-berkeleyx
2. https://online.stanford.edu/courses
3. https://www.edx.org

Course Outcomes:

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

1. Design and implement basic IPC using pipes, fifos, System V IPC for client-server applications.
2. Understand Fundamental concept of Network Programming.
3. Know Contemporary Issues in Network Technologies.
4. Design network Client-Server applications using TCP and UDP Sockets
5. Create client and server applications using the "Socket" API and also analyze Network Programming.
6. Create RPC for Unix environment.

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Department of Information Technology

I Year M.Tech. CNIS I Sem **L T P C**
3 - - 3

TCP/IP INTERNETWORKING
(Program Specific Elective-1)

Prerequisites: Knowledge of architecture, Operating Systems, Programming and Probability.

Course Objectives:

1. To explain the major functions of networks with TCP/IP model
2. To explain the protocols of Network Layer
3. To understand the transport layer protocols of TCP/IP model
4. To understand client server mechanisms with the protocols such as DNS & Telnet.
5. To understand transfer of data and management of networks using application layer protocols

UNIT 1: (~ 9 Lecture Hours**)**
Introduction to TCP/IP, The OSI Model and TCP/IP Protocol Suites, Underlying Technologies; IP Addressing, Sub netting and Super netting, CIDR, Delivery and Routing of IP Packets

UNIT 2: (~ 8 Lecture Hours**)**
Internet Protocol (IP), ARP and RARP, Internet Control Message Protocol (ICMP), Internet Group Management Protocol (IGMP)

UNIT 3: (~ 10 Lecture Hours**)**
User Datagram Protocol (UDP), Transmission Control Protocol (TCP) ; Routing Protocols (RIP, OSPF, HELLO and BGP)

UNIT 4: (~ 6 Lecture Hours**)**
Application Layer and Client-Server Model, BOOTP and DHCP; Domain Name System (DNS), Telnet and Rlogin

UNIT 5: (~ 12 Lecture Hours**)**
File Transfer Protocol (FTP), Trivial File Transfer Protocol (SMTP), Simple Network Management Protocol (SNMP), Hyper Text Transfer Protocol (HTTP)

Text Books:

1. Douglas E. Comer, “Internetworking with TCP/IP, Principles, Protocols and Architectures”, Vol. I, Fourth Edition, PHI.
2. Forouzan BA, “TCP/IP Protocol Suite”, TMH (2000)

Reference Books:

1. TCP/IP Unleashed, Pearson Education.
2. Richard Stevens, TCP/IP Illustrated, Vol. 1. Addison Wesley Publisher.
3. Charles M. Kozierok, The TCP/IP Guide: A Comprehensive, Illustrated Internet Protocols Reference 1st Edition.

Online Resources:

1. https://mikrotik.com/documentation/TCP-IP_Resources_List.htm
2. http://cpe.rmutt.ac.th/network/images/cn/[3]Comer_Douglas_Internetworking_with_TCP_IP_Vol.1.pdf
3. http://clweb.csa.iisc.ernet.in/kdinesh/Comer-TCPIP.pdf
4. http://www.it.iut.ac.ir/sites/fsites/it/files/u4/uploads/Chapter04-5th_2011.pdf
5. https://www.coursera.org

Course Outcomes:

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

1. Demonstrate an understanding of the TCP/IP layers to design subnets and supernets.
2. Identify the services that TCP/IP applications provide.
3. Ability to identify the protocols of transport layer along with frame formats.
4. To understand and comprehend the use of application layer protocols.
5. To demonstrate and use the Application layer protocols for developing real time Applications.
6. To describe current common protocols of file different transferring techniques.

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Department of Information Technology

I Year M.Tech. CNIS - I Sem

L	T	P	C
3	-	-	3

DIGITAL FORENSICS

(Program Specific Elective-2)
(Common to CNIS & CSE)

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 and Elsevier, The Basics of Digital Forensics.

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/lectures.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
4. https://www.coursera.org/
5. https://onlinecourses.nptel.ac.in/

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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Department of Information Technology

I Year M.Tech. CNIS - I Sem **L T P C**
3 - - 3

INTRUSION DETECTION
(Program Specific Elective-2)

Prerequisites: Computer Networks, Computer Programming.

Course Objectives:

1. Compare alternative tools and approaches for Intrusion Detection through quantitative analysis to determine the best tool or approach to reduce risk from intrusion.
2. Identify and describe the parts of all intrusion detection systems and characterize new and emerging IDS technologies according to the basic capabilities all intrusion detection systems share.

UNIT 1: (~ 9 Lecture Hours**)**
The state of threats against computers, and networked systems-Overview of computer security solutions and why they fail-Vulnerability assessment, firewalls, VPN's -Overview of Intrusion Detection and Intrusion Prevention, Network and Host-based IDS.

UNIT 2: (~ 9 Lecture Hours**)**
Classes of attacks - Network layer: scans, denial of service, penetration Application layer: software exploits, code injection-Human layer: identity theft, root access-Classes of attackers-Kids/hackers/sop Hesitated groups-Automated: Drones, Worms, Viruses.

UNIT 3: (~ 8 Lecture Hours**)**
A General IDS model and taxonomy, Signature-based Solutions, Snort, Snort rules, Evaluation of IDS, Cost sensitive IDS.

UNIT 4: (~ 10 Lecture Hours**)**
Anomaly Detection Systems and Algorithms-Network Behaviour Based Anomaly Detectors (rate based)-Host-based Anomaly Detectors-Software Vulnerabilities-State transition, Immunology, Payload Anomaly Detection.

UNIT 5: (~ 9 Lecture Hours**)**
Attack trees and Correlation of alerts- Autopsy of Worms and Botnets, Malware detection, Obfuscation, polymorphism- Document vectors.

Email/IM security issues-Viruses/Spam-From signatures to thumbprints to zero day detection-Insider Threat issues-Taxonomy-Masquerade and Impersonation Traitors, Decoys and Deception-Future: Collaborative Security.

Text Books:

1. Peter Szor, The Art of Computer Virus Research and Defense, Symantec Press ISBN 0-321-30545-3.
2. Markus Jakobsson and Zulfikar Ramzan, Crimeware, Understanding New Attacks and Defenses.

Reference Books:

1. Saiful Hasan, Intrusion Detection System, Kindle Edition.
2. Ankit Fadia, Intrusion Alert: An Ethical Hacking Guide to Intrusion Detection.

Online Resources:

1. https://www.intechopen.com/books/intrusion-detection-systems
2. https://www.sans.org/course/intrusion-detection-in-depth
3. https://www.cybrary.it/skill-certification-course/ids-ips-certification-training-course

Course Outcomes:

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

1. Possess a fundamental knowledge of Cyber Security.
2. Understand what vulnerability is and how to address most common vulnerabilities.
3. Know basic and fundamental risk management principles as it relates to Cyber Security and Mobile Computing.
4. Have the knowledge needed to practice safer computing and safeguard your information using Digital Forensics.
5. Understand basic technical controls in use today, such as firewalls and Intrusion Detection systems.
6. Understand legal perspectives of Cyber Crimes and Cyber Security.

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Department of Information Technology

I Year M.Tech. CNIS - I Sem **L T P C**
3 - - 3

INFORMATION THEORY AND CODING
(Program Specific Elective-2)

Prerequisites: Computer Networks, Computer Programming, Working knowledge of algebra and probability, Digital Communications

Course Objectives:
1. To equip students with the basic understanding of the fundamental concept of entropy and information as they are used in communications.
2. To introduce information theory, the fundamentals of error control coding techniques and their applications.
3. To guide the students through the implications and consequences of fundamental theories and laws of information theory and its applications in modern communication systems.

UNIT 1: (~ 8 Lecture Hours**)**
Information Theory- Overview, Basic Concepts - Entropy and Mutual information.

UNIT 2: (~ 9 Lecture Hours**)**
Lossless Source Coding - Source entropy rate Kraft inequality, Huffman code, Asymptotic equipartition property, Universal coding, Noisy Channel Coding - Channel capacity.

UNIT 3: (~ 8 Lecture Hours**)**
Random channel codes, Noisy channel coding theorem for discrete memoryless channels.

UNIT 4: (~ 10 Lecture Hours**)**
Typical sequences, Error exponents, Feedback, Continuous and Gaussian channels, Lossy Source Coding - Rate- Distortion functions.

UNIT 5: (~ 9 Lecture Hours**)**
Random source codes, Joint source-channel coding and the separation theorem. Compression as a Case Study (LZ & MPEG).

Text Books:
1. S. Lin and D. J. Costello, Error Control Coding – Fundamentals and Applications, 2nd Edition, Pearson Education Inc., NJ., USA, 2004

2. S. Lin and D. J. Costello, Error Control Coding, 2nd Edition, Prentice Hall, 1983.

Reference Books:

1. R. Bose, Information Theory, Coding and Cryptography, Tata McGraw-Hill, 2003.
2. E. R. Berlekamp, Algebraic Coding Theory, McGraw-Hill, New York, 1968.
3. R. E. Blahut, Algebraic Codes for Data Transmission, Cambridge University Press Cambridge, UK, 2003.

Online Resources:

1. https://www.springer.com/in/book/9783642203466
2. https ://www.coursera.org/learn/information-theory
3. https://www.coursera.org

Course Outcomes:

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

1. Understand the ideas of entropy and information content and Derive equations for entropy mutual information.
2. Derive equations for channel capacity for all types of channels.
3. Analyse information carrying capacity of communication channels.
4. Distinguish between different types of error correcting codes based on probability of error
5. Construct efficient codes for data on imperfect communication channels.
6. Apply the best compression techniques to practical situations.

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Department of Information Technology

I Year M.Tech. CNIS - I Sem **L T P C**
- - 4 2

ADVANCED DATA STRUCTURES LAB
(Common to CNIS & CSE)

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.

List of Programs:
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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Department of Information Technology

I Year M.Tech. CNIS - I Sem **L T P C**
- - 4 2

COMPUTER NETWORKING LAB
(Program Specific Elective-1)

Prerequisites: C or Java Programming, TCL scripting.

Course Objectives:
1. Implement important computer networking protocols in a high, level programming language.
2. Will be acquainted with some of the important GUI based computer networking tools used for simulation such as NetSim/NS2.
3. Understand how the data transferred from source to destination.
4. Able to know how routing algorithms worked out in Network layer.

Use C/Java Programming Language to implement the following:
Week 1:
Implement the data link layer farming methods such as character stuffing and bitstuffing.

Week 2:
Implement on a data set of characters the three CRC polynomials, CRC 12, CRC 16 and CRC CCITT

Week 3:
Implement Dijkstra‘s algorithm to compute the Shortest path through a graph.

Week 4:
Take an example subnet graph with weights indicating delay between nodes. Now obtain Routing table at each node using distance vector routing algorithm.

Week 5:
Take an example subnet of hosts. Obtain broadcast tree for it.

Use Simulation tools like NetSim/NS2, etc. to implement the following:
Week 6:
a) Installation of simulation tools in Linux/Windows environment

b) Introduction about discrete events simulation and its tools like NetSim, NS2, etc.

Week 7:
Understand IP forwarding within a LAN and across a router.

Week 8:
Study the throughputs of Slow start + Congestion avoidance (Old Tahoe) and Fast Retransmit (Tahoe) Congestion Control Algorithms.

Week 9:
Study how the Data Rate of Wireless LAN (IEEE 802.11b) Network varies as the distance between the Access Point and the wireless nodes is varied.

Week 10:
Write a script to connect two nodes.

Week 11:
Write a script for connecting three nodes considering one node as a central node.

Week 12:
a) Write a script to implement Bus topology.
b) Write a script to implement Star topology.

Text Books:
1. Andrew S. Tanenbaum and David J. Wetherall, Computer Networks, Pearson, 5th Edition, 2014.
2. Marc Snir, "Netsim" Network Simulator for the Ultra computer (Classic Reprint) Reference Books.
3. Issariyakul**,** Teerawat, Hossain and Ekram, Introduction to Network Simulator NS2, 2nd Edition.

Reference Books:
1. Behrouz A. Forouzan, Data Communications and Networking, 4th Edition, Tata McGraw Hill.
2. Priscilla Oppenheimer, Top-Down Network Design, 2nd Edition, Pearson Education (CISCO Press)

Online Resources:
1. https://www.tetcos.com
2. https://www.isi.edu

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

1. Understand computer network basics, network architecture, and TCP/IP and OSI reference models.
2. Familiar with contemporary issues in networking technologies.
3. Familiar with network tools and network programming.
4. Describe routing and congestion in network layer with routing algorithms.
5. Describe data link protocols and IEEE 802 standards for LAN.
6. Have a basic knowledge to write a script.

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Department of Information Technology

I Year M.Tech. CNIS - I Sem **L T P C**

- - 4 2

NETWORK PROGRAMMING LAB

(Program Specific Elective-1)

Prerequisites: Basic knowledge of programming and network fundamentals.

Course Objectives:

1. Students will implement various forms of IPC through Unix and socket Programming.

List of Programs:

Week 1:

Implement the IPC using pipes.

Week 2:

Implement the IPC using FIFO‘s

Week 3:

Implement file transfer using Message Queue form of IPC.

Week 4:

Write a program to create an integer variable using shared memory concept and increment the variable simultaneously by two processes. Use semaphores to avoid race conditions

Week 5:

Design TCP iterative Client and Server application to reverse the given input sentence

Week 6:

Design TCP Client and Server application to transfer file

Week 7:

Design a TCP Concurrent Server to convert a given text into upper case using I/O multiplexing system call ―select.

Week 8:

Design a TCP Concurrent Server to echo given set of sentences using poll function.

Week 9:
Design UDP Client and Server application to reverse the given input sentence

Week 10:
Design UDP Client Server to transfer a file

Week 11:
Design using Poll function, Client Server application to multiplex TCP and UDP requests for converting a given text into upper case.

Week 12:
Design a RPC application to add and subtract a given pair of integers

Text Books:
1. W.Richard Stevens, UNIX Network Programming, Vol. I, Sockets API, 2nd Edition. - Pearson Edn. Asia.
2. W.Richard Stevens , UNIX Network Programming, 1st Edition, - PHI.

Reference Books:
1. Richard Stevens, Advance Unix Programming, 2nd Pearson Education.
2. N.B. Venkateswarlu, Advance Unix Programming, BS Publication.

Online Resources:
1. https://www.edx.org/school/uc-berkeleyx
2. https://online.stanford.edu/courses
3. https://www.edx.org

Course Outcomes:
After completion of the course, students will be able to:
1. Implement basic IPC using pipes, fifos.
2. Implement system V IPC for client-server applications.
3. Implement Client, Server applications using TCP and UDP Sockets.
4. Implement Client-Server applications using multiplexing using select.
5. Implement client and server applications using the poll.
6. Implement RPC for Linux environment.

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Department of Information Technology

I Year M.Tech. CNIS - I Sem

L	T	P	C
-	-	4	2

TCP/IP INTERNETWORKING LAB

(Program Specific Elective-1)

Prerequisites:

1. knowledge of architecture, Operating Systems, Programming and probability.

Course Objectives:

1. To install and get aquainted with Linux environment
2. To know about networking tool in Linux
3. To learn to install and use wireshark to understand protocols
4. To learn about a network simulator

List of Tasks:

- **Introducing Linux Environment:**
  Installing Ubuntu Linux and learning the usage of basic commands, text editing tools, installing software, compiling the code etc.

- **Using networking tools** (ifconfig, ethtool, ping, tracepath, nslookup, route, arp, netstat, dhclient)

1. View the configuration details, including addresses, of your computers network interfaces.
2. Test the network connectivity between your computer and several other computers: another PC in the lab;; external web servers.
3. Using one of the publicly available websites for ping/traceroute, test the connectivity to several external websites.
4. Trace the path between several pairs of source/destination nodes.
5. Find the IP addresses of several web servers (domains), using several different DNS servers.
6. Try a reverse DNS lookup.
7. View your routing table and routing cache.
8. View your ARP cache. Find the hardware address of another computer in the lab using ARP
9. View the active TCP connections that your computer has, especially after you visited a website.
10. View and browse through the summary network statistics.
11. View the DHCP lease information for your computer, and see how it changes as you renew/refresh the lease.

- **Using Wire Shark & tcpdump**

1. Capture packets when "pinging" another computer. Understand how ping works from the packet capture.
2. Capture packets transferred while browsing a selected website (e.g. a page from the course website, a search engine home page). Investigate the protocols used in each packet, the values of the header fields and the packet sizes
3. Explore at least the following features of Wireshark: filters, Flow Graphs (TCP), statistics, protocol hierarchies.

- **Experiments using Simulator NS-2**

1. Installing the network simulator NS-2 on ubuntu
2. Simple topology creating using NS-2
3. To implement User Datagram Protocol using NS-2
4. To implement TCP using NS-2
5. Performance comparision of routing protocols
6. Study of TCP/UDP performance
7. TCP/UDP performance comparision

Text Books:

1. L. Peterson and B. Davie. Morgan, Computer Networks: A Systems Approach, Kaufmann Publishers Inc., 1996.
2. Richard Stevens, TCP/IP Illustrated, Vol. 1, Addison Wesley Publisher.
3. Craig Hunt, TCP/IP Network Administration, O'Reilly & Associates, Inc.
4. Raj Jain. John Wiley, The Art of Computer Systems Performance Analysis, New York, 1991.

Online Resources:

1. www.ubuntu.com
2. www.wireshark.com
3. www.isi.edu/nsnam/ns
4. www.tcpiplab.net
5. http://udacity.ac.in

Course Outcomes:

1. Able to install and use commands in ubuntu OS
2. Able to identify network tools in Linux and understand their usage to comprehend TCP/IP protocols

3. Able to use tcpdump , wireshark to look at the packets and understand and analyze protocols
4. Understand a open source network simulator and use it to create a network model and analyze its performance with various parameters

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Department of Information Technology

I Year M.Tech. CNIS I-Semester

L	T	P	C
2	-	-	2

RESEARCH METHODOLOGY AND IPR

Prerequisites: ---

Course Objectives:

- To develop an understanding of IPR/ research methodology in the process of creation of patents through research.
- To develop further research capabilities.

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.

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Department of Information Technology

I Year M.Tech. CNIS I-Semester	**L**	**T**	**P**	**C**
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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 Pv1t. 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. https://onlinecourses.nptel.ac.in/noc18_mg13/preview

Course Outcomes:

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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(For Women)

(AUTONOMOUS)
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Department of Information Technology

I Year M.Tech. CNIS I - Semester	**L**	**T**	**P**	**C**
	2	**-**	**-**	**-**

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.
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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 and Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, Pardeep Et.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. Sharman and Hansen, Aim and Scope of Disaster Management. Study Guide prepared by 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:

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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I Year M.Tech. CNIS I-Semester

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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.

Text Books:

1. Ackers J and 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 and 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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I Year M.Tech. CNIS I-Semester	**L**	**T**	**P**	**C**
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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 (dont'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.

Reference Books:

1. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram (Publication Department), Kolkata.
2. P. Gopinath, Bhartrihari's ThriSatakam (Niti – Sringar- Vairagya), Rashtriya Sanskrit Sansthanam, New Delhi.

Online Courses:

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

Course outcome:

The students 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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I Year M.Tech. CNIS II-Semester **L T P C**
3 - - 3

ADVANCED ALGORITHMS
(Common to CNIS & CSE)

Prerequisites: Design and Analysis of Algorithm

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, Heap Sort, Quick Sort, 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/
2. www.coursera.org

Course Outcomes:

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

1. Analyze 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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I Year M.Tech. CNIS - II Sem **L T P C**
3 - - 3

CYBER SECURITY

Prerequisites: ---

Course Objectives:
1. Able to learn about cybercrimes and how they are planned.
2. Able to learn the vulnerabilities of mobile and wireless devices.
3. Able to learn about the crimes in mobile and wireless devices.

UNIT 1: (~ 9 Lecture Hours**)**
Introduction to Cybercrime: Introduction, Cybercrime and Information security, who are cyber criminals, Classifications of Cybercrimes, Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.
Cyber offenses: How criminals Plan Them: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, and Cloud Computing.

UNIT 2: (~ 9 Lecture Hours**)**
Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies an Measures in Mobile Computing Era, Laptops.

UNIT 3: (~ 9 Lecture Hours**)**
Cybercrimes and Cyber security: the Legal Perspectives
Introduction: Cyber Crime and Legal Landscape around the world, Why Do We Need Cyber laws: The Indian Context, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario In India, Digital signatures and the Indian IT Act, Amendments to the Indian IT Act, Cybercrime and Punishment Cyber law, Technology and Students: Indian Scenario.

UNIT 4: (~ 9 Lecture Hours**)**

Understanding Computer Forensics: Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Chain of Custody concept, Network Forensics, Approaching a computer, Forensics Investigation, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing.

UNIT 5: (~ 9 Lecture Hours**)**

Cyber Security: Organizational Implications: Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

Text Books:

1. Nina Godbole and Sunil Belapure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley INDIA.
2. Chwan-Hwa (john) Wu and J.David Irwin, Introduction to Cyber Security, CRC Press T&F Group.

Reference Books:

1. James Graham, Richard Howard and Ryan Otson, Cyber Security Essentials, CRC Press.

Online Resources:

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-858-computer-systems-security-fall-2014/video-lectures/
2. https://www.edx.org/course/introduction-cybersecurity-uwashingtonx-cyb001x
3. https://www.edx.org/course/cybersecurity-cisos-view-uwashingtonx-cyb002x
4. https://www.edx.org/course/building-cybersecurity-toolkit-uwashingtonx-cyb003x

Course Outcomes:

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

1. Possess a fundamental knowledge of Cyber Security.
2. Understand what vulnerability is and how to address most common vulnerabilities.
3. Know basic and fundamental risk management principles as it relates to Cyber Security and Mobile Computing.
4. Have the knowledge needed to practice safer computing and safeguard your information using Digital Forensics.
5. Understand basic technical controls in use today, such as firewalls and Intrusion Detection systems.
6. Understand legal perspectives of Cyber Crimes and Cyber Security.

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I Year M.Tech. CNIS - II Sem **L T P C**
3 - - 3

CLOUD COMPUTING
(Program Specific Elective-3)

Prerequisites: Knowledge of Operating Systems, Networking, Basic understanding of Data Communications, Networking Technologies.

Course Objectives:
1. Able to explain evolving computer model called cloud computing.
2. Introduce the various levels of services that can be achieved by cloud.
3. Able to describe the security aspects of cloud.

UNIT 1: (~ 8 Lecture Hours**)**
Introduction- Cloud computing at a glance, Historical developments, Building cloud computing environments
Cloud Computing Architecture - The cloud reference model, Types of clouds, Economics of the cloud, Open challenges.

UNIT 2: (~ 8 Lecture Hours**)**
Virtualization - Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing , Pros and cons of virtualization, Technology examples- Xen , VMware, Microsoft Hyper-V, Migrating into a Cloud , Virtual Machines Provisioning and Migration Services.

UNIT 3: (~ 11 Lecture Hours**)**
Cloud Platforms in Industry - Amazon web services, Google AppEngine, Microsoft Azure, Aneka-Integration of private and public cloud.
Cloud Applications- Scientific applications, Business and consumer applications.
SLA Management - Traditional Approaches to SLO Management, Types of SLA , Life Cycle of SLA, SLA Management in Cloud , Automated Policy-based Management.

UNIT 4: (~ 9 Lecture Hours**)**
Python Basics, Python for cloud, cloud application development in python. Programming **Google App engine with python:** A first real cloud application, Managing data in the cloud, Google app engine services for Login Authentication, Optimizing UI and logic,

Making the UI pretty: Templates and CSS, Getting interactive. Map Reduce Programming Model and implementations.

UNIT 5: (~ 9 Lecture Hours**)**

Security in the Cloud- Cloud Security Challenges, Software-as-a-Service Security.

Secure Distributed Data Storage in Cloud Computing - Cloud Storage: from LANs TO WANs, Technologies for Data Security in Cloud Computing.

Data Security in the Cloud- The Current State of Data Security in the Cloud, Cloud Computing and Data Security Risk, Cloud Computing and Identity, The Cloud, Digital Identity, and Data Security, Content Level Security—Pros and Cons.

Text Books:

1. Rajkumar Buyya, Christian Vecchiola and S.Thamarai Selvi, Mastering Cloud Computing: Foundations and Applications Programming By 2013 McGraw Hill Education
2. Rajkumar Buyya, James Broberg and Andrzej, Cloud Computing: Principles and paradigms Wiley,2011
3. John W. Rittinghouse and James F. Ransome, Cloud Computing: Implementation, Management, and Security.
4. Arshadeep Bhaga and Vijay Madisetti, Cloud computing 2014 University press
5. Dr. Kumar Saurab, Cloud computing Wiley India 2011

Reference Books:

1. Kai Hwang, Geoffery C.Fox, Jack J Dongarra and Elsevier, Distributed and cloud computing, 2012.
2. A. Kannammal, Fundamentals of Cloud Computing.
3. Tim Mather, Subra Kumaraswamy and Shahed Latif, Cloud Security and Privacy. An Enterprise Perspective on Risks and Compliance. Publisher: O'Reilly Media 2009.
4. Kenneth A.Lambert and B.L.Juneja Fundamentals of python.

Online Resources:

1. https://azure.microsoft.com/en-in/overview/what-is-cloud-computing/
2. https://www.zdnet.com/article/what-is-cloud-computing-everything-you-need-to-know-from-public-and-private-cloud-to-software-as-a/

Course Outcomes:

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

1. Articulate the main concepts, key technologies, strengths, and limitations of cloud computing.
2. Illustrate the broad perceptive of cloud architecture and model.

3. Apply and design suitable Virtualization concept.
4. Explore some important cloud computing driven commercial systems such as Google Apps, Microsoft Azure and Amazon Web Services and other businesses cloud applications.
5. Assess cloud Storage systems and Cloud security, the risks involved, its impact and develop cloud application.
6. Develop applications for cloud.

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I Year M.Tech. CNIS - II Sem **L T P C**
3 0 0 3

STORAGE AREA NETWORKS

(Program Specific Elective-3)

Prerequisites: Basics in Computer Networks.

Course Objectives:
Apply the knowledge of different Storage techniques to practice scalable data universe generated by heterogeneous devices and understand the role of a storage system for a highly available self-sustainable business solutions that are robust and secure.

UNIT 1: (~ 10 Lecture Hours**)**
Introduction to information storage, virtualization and cloud computing, Key data center elements, Compute, application, and storage virtualization, Disk drive & flash drive components and performance, RAID, Intelligent storage system and storage provisioning (including virtual provisioning).

UNIT 2: (~ 10 Lecture Hours**)**
Fibre Channel SAN components, FC protocol and operations, Block level storage virtualization, iSCSI and FCIP as an IP-SAN solutions, Converged networking option, FCoE, Network Attached Storage (NAS) - components, protocol and operations, File level storage virtualization, Object based storage and unified storage platform.

UNIT 3: (~ 8 Lecture Hours**)**
Business continuity terminologies, planning and solutions, Clustering and multipathing architecture to avoid single points of failure, Backup and recovery - methods, targets and topologies, Data deduplication and backup in virtualized environment, Fixed content and data archive.

UNIT 4: (~ 8 Lecture Hours**)**
Local replication in classic and virtual environments, Remote replication in classic and virtual environments, Three-site remote replication and continuous data protection.

UNIT 5: (~ 9 Lecture Hours**)**
Information Security Framework, Risk Triad, Storage Security Domains, Security Implementations in Storage Networking, Monitoring the Storage Infrastructure, Storage Infrastructure Management Activities, Storage Infrastructure Management Challenges, Developing an Ideal Solution,

Information Lifecycle Management, Information lifecycle management (ILM) and Storage Tiering.

Case Studies:

1. The technologies described in the course are reinforced with EMC examples of actual solutions.

Text Books:

1. EMC Corporation, Information Storage Management, Wiley version2.

Reference Books:

1. Robert Spalding, “Storage Networks: The Complete reference”, Tata McGraw Hill, Osborne, 2003.
2. Marc Farley, “Building Storage Networks”, Tata McGraw Hill, Osborne, 2001.
3. Meeta Gupta, Storage Area Networks Fundamentals, Pearson Education Limited, 2002.

Online Resources:

1. https://en.wikipedia.org/wiki/Storage_area_network
2. https://www.slideshare.net/spmaakash/cp7029-information-storage-management-notes
3. https://www.snia.org/education/whitepapers
4. https://www.youtube.com/watch?v=akEr8cUAd5g
5. http://www.exuberantsolutions.com/san_course.htm
6. http://www.virtualnuggets.com/emcs--storage-area-network.html

Course Outcomes:

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

1. Explain the need for storage management and differentiate between the types of storage architectures and demonstrate the key data center elements in classic, virtualized environments.
2. Describe the components of a storage device, evaluate the need for data protection using RAID and illustrate the role of an Intelligent Storage Systems.
3. Describe storage networking technologies such as FC-SAN, IP-SAN, NAS, and Object-based storage solutions.
4. Determine the role of business continuity solutions that include backup, recovery, archival, local and remote replication.
5. Elaborate the importance of information, storage security domains by Identifying parameters for managing, monitoring and providing solutions to the storage infrastructure.
6. Ability to demonstrate Storage area networks and their products & provide the mechanisms for the backup/recovery, managing and securing Storage infrastructure in research Oriented Style.

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I Year M.Tech. CNIS - II Sem **L T P C**
3 - - 3

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

Prerequisites: Data Base Management Systems, Distributed 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 architecture 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 Lecture Hours**)**

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.cithep.caltech.edu/DistributedDatabasesPakistan.pdf
2. http://web.cs.wpi.edu/~cs561/s12/Lectures/4-5/DistributedDBs.pdf
3. https://www.tutorialspoint.com
4. www.ibm.com
5. www.Knack.com/easy-online-databases

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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I Year M.Tech. CNIS - II Sem **L T P C**
3 - - 3

ETHICAL HACKING
(Program Specific Elective-4)

Prerequisites: Operating Systems, Computer Networks, Network Security and Cryptography.

Course Objectives:
1. Introduce the methodologies and framework of ethical hacking for enhancing the security.
2. Able to understand the Impacts of Hacking, Types of Hackers, Information Security Models, Information Security Program, and Business Perspective.
3. Planning a Controlled Attack, Framework of Steps (Reconnaissance, Enumeration, Vulnerability Analysis, Exploitation, Deliverable and Integration).

UNIT 1: (~ 11 Lecture Hours**)**
Introduction: Hacking Impacts,
The Hacker Framework: Planning the test, Sound Operations, Reconnaissance, Enumeration, Vulnerability Analysis, Exploitation, Final Analysis, Deliverable, and Integration.
Information Security Models: Computer Security, Network Security, Service Security, Application Security, Security Architecture.
Information Security Program: The Process of Information Security, Component Parts of Information Security Program, Risk Analysis and Ethical Hacking.

UNIT 2: (~ 10 Lecture Hours**)**
The Business Perspective: Business Objectives, Security Policy, Previous Test Results, Business Challenges.
Planning for a Controlled Attack: Inherent Limitations, Imposed Limitations, Timing is Everything, Attack Type, Source Point, Required Knowledge, Multi-Phased Attacks, Teaming and Attack Structure, Engagement Planner, The Right Security Consultant, The Tester, Logistics, Intermediates, Law Enforcement.

UNIT 3: (~ 7 Lecture Hours**)**

Preparing for a Hack: Technical Preparation, Managing the Engagement. **Reconnaissance**: Social Engineering, Physical Security, Internet Reconnaissance.

UNIT 4: (~ 9 Lecture Hours**)**
Enumeration: Enumeration Techniques, Soft Objective, Looking Around or Attack, Elements of Enumeration, Preparing for the Next Phase.
Exploitation: Intuitive Testing, Evasion, Threads and Groups, Operating Systems, Password Crackers, RootKits, applications, Wardialing, Network, Services and Areas of Concern.

UNIT 5: (~ 8 Lecture Hours**)**
Deliverable: The Deliverable, the Document, Overall Structure, Aligning Findings, Presentation.
Integration: Integrating the Results, Integration Summary, Mitigation, Defence Planning, Incident Management, Security Policy, Conclusion.

Text Books:

1. James S. Tiller, "The Ethical Hack: A Framework for Business Value penetration Testing", Auerbach Publications, CRC Press

Reference Books:

1. EC-Council, "Ethical Hacking and Countermeasures Attack Phases", Cengage Learning.
2. Michael Simpson and Kent Backman, James Corley, "Hands-On Ethical Hacking and Network Defense", Cengage Learning.

Online Resources:

1. http://www.ethicalhackx.com/certified-ethical-hacking-ceh-v8/
2. https://www.tutorialspoint.com/ethical_hacking/index.htm
3. https://www.cybrary.it/course/ethical-hacking/
4. https://www.hackersonlineclub.com/online-ethical-hacking-training/

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

1. Evaluate a network and system architecture to identify the vulnerabilities and attack vectors.
2. Identify security techniques used to protect the system and data
3. Gain the knowledge of the use and availability of tools to support an ethical hack.
4. Gain the knowledge of interpreting the results of a controlled attack.
5. Understand the role of politics, inherent and imposed limitations and metrics for planning of attest.

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Department of Information Technology

I Year M.Tech. CNIS - II Sem **L T P C**
3 - - 3

MALWARE ANALYSIS
(Program Specific Elective-4)

Prerequisites:
1. Computer Programming

Course Objectives:
1. To provide an insight to fundamentals of malware analysis.
2. Able to understand various malware analysis tools for static analysis.
3. Able to understand various malware analysis tools for dynamic analysis.

UNIT 1: (~ 10 Lecture Hours**)**
Fundamentals of Malware Analysis (MA), Reverse Engineering Malware (REM) Methodology, Brief Overview of Malware analysis lab setup and configuration, Introduction to key MA tools and techniques, Behavioral Analysis vs. Code Analysis, Resources for Reverse-Engineering Malware (REM) Understanding Malware Threats, Malware indicators, Malware Classification, Examining ClamAVSignatures, Creating Custom ClamAV Databases, Using YARA to Detect Malware Capabilities, Creating a Controlled and Isolated Laboratory, Introduction to MA Sandboxes, Ubuntu, Zeltser'sREMnux, SANS SIFT, Sandbox Setup and Configuration New Course Form, Routing TCP/IP Connections, Capturing and Analyzing Network Traffic, Internet simulation using INetSim, Using Deep Freeze to Preserve Physical Systems, Using FOG for Cloning and Imaging Disks, Using MySQL Database to Automate FOG Tasks, Introduction to Python ,Introduction to x86 Intel assembly language, Scanners: Virus Total, Jotti, and NoVirus Thanks, Analyzers: Threat Expert, CWSandbox, Anubis, Joebox, Dynamic Analysis Tools: Process Monitor, Regshot, HandleDiff, Analysis Automation Tools: Virtual Box, VM Ware, Python , Other Analysis Tools.

UNIT 2: (~ 8 Lecture Hours**)**
Using TSK for Network and Host Discoveries, Using Microsoft Offline API to Registry Discoveries, Identifying Packers using PEiD, Registry Forensics with Reg Ripper Plugging, Bypassing Poison Ivy's Locked Files, Bypassing Conficker's File System ACL Restrictions, Detecting Rogue PKI Certificates.

UNIT 3: (~ 8 Lecture Hours**)**

Opening and Attaching to Processes, Configuration of JIT Debugger for Shellcode Analysis, Controlling Program Execution, Setting and Catching Breakpoints, Debugging with Python Scripts and Py Commands, DLL Export Enumeration, Execution, and Debugging, Debugging a VMware Workstation Guest (on Windows), Debugging a Parallels Guest (on Mac OS X). Introduction to WinDbg Commands and Controls, Detecting Rootkits with WinDbgScripts, Kernel Debugging with IDA Pro.

UNIT 4: (~ 9 Lecture Hours**)**
Memory Dumping with MoonSols Windows Memory Toolkit, Accessing VM Memory Files Overview of Volatility, Investigating Processes in Memory Dumps, Code Injection and Extraction, Detecting and Capturing Suspicious Loaded DLLs, Finding Artifacts in Process Memory, Identifying Injected Code with Malfind and YARA.

UNIT 5: (~ 10 Lecture Hours**)**
Using WHOIS to Research Domains**,** DNS Hostname Resolution**,** Querying Passive DNS**,** Checking DNS Records**,** Reverse IP Search New Course Form**,** Creating Static Maps**,** Creating Interactive Maps. Case study of Finding Artifacts in Process Memory, Identifying Injected Code with Malfind and YARA.

Text Books:

1. Michael Hale Ligh, Steven Adair, Blake Hartstien, Matthew Richard , Malware Analyst's Cookbook and DVD 2011 by Wiley Publishing.

Reference Books:

1. Michael Sikorski, Andrew Honig "Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software" By Williampollock publishing.

Online Resources:

1. http://usdatavault.com/library/Windows%20Malware%20Analysis%20Essentials.pdf
2. https://zeltser.com/media/docs/intro-to-malware-analysis.pdf
3. https://github.com/wtsxDev/Malware-Analysis
4. https://www.coursera.org/
5. https://onlinecourses.nptel.ac.in/

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

1. Possess the skills necessary to carry out independent analysis of modern malware samples using both static and dynamic analysis techniques.
2. Have an intimate understanding of executable formats.
3. Apply Windows internals and API, and analysis techniques.
4. Extract investigative leads from host and network based indicators associated with a malicious program.

5. Apply techniques and concepts to unpack, extract, decrypt, or bypass new anti-analysis techniques in future malware samples.
6. Achieve proficiency with industry standard tools including IDA Pro, OllyDbg, WinDBG, PE Explorer, ProcMon etc.

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Department of Information Technology

I Year M.Tech. CNIS - II Sem

L	T	P	C
3	-	-	3

INFORMATION SECURITY
(Program Specific Elective-4)

Prerequisites: Fundamental concepts of number theory, Network system and Computer system.

Course Objectives:

1. Understand the basic categories of threats to computers and networks.
2. Understand various symmetric and asymmetric cryptographic algorithms.
3. Describe the enhancements made to IPv4 by IPSec.
4. Understand Intrusions and intrusion detection
5. Generate and distribute a PGP key pair and discuss Web security and Firewalls.

UNIT 1: (~ 8 Lecture Hours**)**

Attacks on Computers and Computer Security: Introduction, The need for security, Security approaches, Principles of security, Types of attacks, Security services, Security Mechanisms, A model for Network Security.

Cryptography-Concepts and Techniques: Introduction, plain text and cipher text,, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography, key range and key size, possible types of attacks.

UNIT 2: (~ 10 Lecture Hours**)**

Symmetric key Ciphers: Block Cipher principles & Algorithms (DES, AES, Blowfish), Differential and Linear Cryptanalysis, Block cipher modes of operations, Stream ciphers, RC4.

Asymmetric key Ciphers: Principles of public key cryptosystems, Algorithms (RSA, Diffie-Hellman, ECC), Location and placement of encryption function, Key distribution.

Case study: Virtual Elections.

UNIT 3: (~ 10 Lecture Hours**)**

Message Authentication Algorithms and Hash Functions: Authentication requirements, Functions, Message authentication codes, Hash Functions, Secure hash algorithm, Whirlpool, HMAC, CMAC, Digital signatures, DSS.

Authentication Applications: Kerberos, X.509 Authentication Service, Public , Key Infrastructure, Biometric Authentication.

UNIT 4: (~ 8 Lecture Hours**)**
E-Mail Security: Pretty Good Privacy, S/MIME.
IP Security: IP Security overview, IP Security architecture, Authentication Header, Encapsulating security payload, combining security associations, key management.
UNIT 5: (~ 9 Lecture Hours**)**
Web Security: Web security considerations, Secure Socket Layer, Transport Layer Security, Secure electronic transaction.
Case study: Secure Inter-branch Payment Transactions
Intruders, Virus and Firewalls: Intruders, Intrusion detection, password management, Virus and related threats, Countermeasures, Firewall design principles, Types of firewalls.

Text Books:

1. William Stallings, Cryptography and Network Security, Principles and Practices, 4th Edition Prentice hall
2. Atul Kahate, Cryptography and Network Security, Mc Graw Hill, 3rd Edition
3. Bernard Menezes, Network Security and Cryptography, CENGAGE Learning

Reference Books:

1. William Stallings, Network Security Essentials (Applications and Standards), Pearson Education, 3rd Edition.
2. C K Shyamala, N Harini and Dr T R Padmanabhan, Cryptography and Network Security, Wiley India, 1st Edition.
3. Forouzan Mukhopadhyay, Cryptography and Network Security Mc Graw Hill, 2nd Edition.
4. Mark Stamp, Information Security, Principles and Practice Wiley India.

Online Resources:

1. http://www.omnisecu.com/security
2. https://www.tutorialspoint.com/itil/information_security_management.htm
3. https://www.tutorialspoint.com/computer_security/index.htm
4. https://onlinecourses.nptel.ac.in
5. https://www.futurelearn.com/courses/introduction-to-cyber-security

Course Outcomes:

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

1. Describe the security model, identify various security threats and indicate countermeasures.
2. Illustrate various symmetric and asymmetric ciphers.
3. Demonstrate various message authentication algorithms and applications.
4. Explain/Present the overview of E-Mail security and IP-Sec.
5. Explain/Present the overview of Web Security.

6. Distinguish between various levels of System security.

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Department of Information Technology

I Year M.Tech. CNIS - II Sem **L T P C**
- - 4 2

ADVANCED ALGORITHMS LAB
(Common to CNIS & CSE)

Prerequisites: Computer Programming and Java Language.

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

List of Programs:
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. Aho, Hopcroft and 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 analyze 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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Department of Information Technology

I Year M.Tech. CNIS - II Sem **L T P C**
- - 4 2

ETHICAL HACKING LAB
(Program Specific Elective-4)

Prerequisites: Knowledge of TCP/IP, Information system and Security Basics.

Course Objectives:
1. To introduce students to various Information Security Models; Information Security Program; Business Perspective; Planning a Controlled Attack.
2. To implement the methodologies and framework of ethical hacking for enhancing the security.

List of Tasks:
Week 1:
Using Active and Passive Techniques for scanning Networks, Enumeration, Sniffing to Enumerate Network Hosts.

Week 2:
Conducting Active and Passive Footprinting and Reconnaissance against Target.

Week 3:
Using Armitage to Attack the Network.

Week 4:
Using Metasploit to Attack a Remote System - Scanning Networks, Enumeration, Sniffers, Evading IDS, Firewalls, and Honeypots.

Week 5:
Using Malware – Dark Comet for System Hacking, Trojans and Backdoors, Viruses and Worms.

Week 6:
Using the SHARK Remote Administration Tool for System Hacking, Trojans and Backdoors, Viruses and Worms.

Week 7:
Attacking a System- Using the SYSTEM account – System Hacking,

Intrusion Detection –Evading IDS, Firewalls and Honeypots.

Week 8:
Packet sniffing techniques and how to defend against sniffing

Week 9:
Social Engineering techniques, identify theft, and social engineering countermeasures.

Week 10:
Penetration Testing and justification of penetration testing through risk analysis.

Week 11:
Web-Based Hacking Servers and Applications for exploitation with IPv6 – System Hacking, Denial of Service, SQL Injection – Hacking Webservers, Hacking Web Applications, SQL Injection, Launching a Buffer Overflow – System Hacking, Buffer Overflow.

Week 12:
Cryptography - Breaking Windows Passwords –System Hacking, Using John the Ripper to Crack Linux Passwords – System Hacking, Using Certificates to Encrypt Email–Cryptography.

Text Books:

1. James S. Tiller, "The Ethical Hack: A Framework for Business Value penetration Testing", Auerbach Publications, CRC Press

Reference Books:

1. EC-Council, "Ethical Hacking and Countermeasures Attack Phases", Cengage Learning.
2. Michael Simpson and Kent Backman, James Corley, "Hands-On Ethical Hacking and Network Defense", Cengage Learning.
3. Greg Meyer and Steven Casco (2002) Hack proofing ColdFusion, Syngress Publishers.
4. Harold F. Tipton and Micki Krause (2004) Information security management handbook, 5th Edition, CRC Press Publications, pp. 2036.

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

1. Evaluate a network and system architecture to identify the vulnerabilities and attack vectors.
2. Identify security techniques used to protect the system and data
3. Gain the knowledge of the use and availability of tools to support an ethical hack.

4. Gain the knowledge of interpreting the results of a controlled attack.
5. Understand the role of politics, inherent and imposed limitations and metrics for planning of attest.
6. Prepare Deliverables and use them productively for enhancing mitigation and developing remedies for vulnerabilities.

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Department of Information Technology

I Year M.Tech. CNIS - II Sem **L T P C**
- - 4 2

MALWARE ANALYSIS LAB
(Program Specific Elective-4)

Prerequisites: Computer Programming.

Course Objectives:
1. Ability to understand the usage of various tools for malware analysis.
2. Ability to understand the tools available for debugging.
3. Ability to understand tools for analyzing network traffic, dissecting malware in memory images.

Learn to use the following tools for malware Analysis
1. Antivirus and other malware identification tools
    a. YARA
2. Web-based multi-AV scanners and malware sandboxes for automated analysis.
    a. CUCKOO/Virus Total
3. Domain analysis Tools
    a. WHOIS
4. Debugging and Reverse Engineering
    a. IDA Pro - Windows disassembler and debugger, with a free evaluation version.
    b. WInDbg: multipurpose debugger for the Microsoft Windows computer operating system, used to debug user mode applications, device drivers, and the kernel-mode memory dumps.
    c. X64Dbg: An open-source x64/x32 debugger for windows.
5. Analyze network interactions
    a. WireShark: The Netrok Traffic analysis tools
6. Tools for dissecting malware in memory images or running systems
    a. WindDbg: Live memory inspection and kernel debugging for Windows systems.

Text Books:
1. Michael Hale Ligh, Steven Adair, Blake Hartstien and Matthew Richard, Malware Analyst's Cookbook and DVD 2011 by Wiley Publishing.

Reference Books:

1. Michael Sikorski and Andrew Honig “Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software” By Williampollock publishing.

Online Resources:

1. https://resources.infosecinstitute.com/step-by-step-tutorial-on-reverse-engineering-malware-the-zeroaccessmaxsmiscer-crimeware-rootkit
2. https://doc.lagout.org/security/Malware%20%26%20Forensics/Practical%20Malware%20Analysis.pdf
3. https://www.crysys.hu/downloads/vihimb01/2017/MW-meres.pdf
4. https://www.coursera.org

Course Outcomes:

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

1. To understand the concept of malware and reverse engineering and various tools.
2. Implement tools and techniques of malware analysis.
3. To understand memory forensics tools.
4. To understand dynamic analysis.
5. To learn the application of YARA.

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Department of Information Technology

I Year M.Tech. CNIS - II Sem

L	T	P	C
-	-	4	2

INFORMATION SECURITY LAB

(Program Specific Elective-4)

Prerequisites: Knowledge of any programming language.

Course Objectives:

1. Understand various network security aspects.
2. Implement various cryptographic algorithms.
3. Implement authentication and digital signatures algorithms.

List of Programs:

Week 1:
Implement the logic that contains a string (char pointer) with a value 'Hello world', XOR each character in this string with 0 and displays the result.

Week 2:
Implement the logic that contains a string (char pointer) with a value 'Hello world', AND or/ and XOR each character in this string with 127 and display the result.

Week 3:
Implement encryption and decryption using following techniques
a) Ceaser cipher b) Play fair Cipher.

Week 4:
Implement encryption and decryption using following techniques
a) Hill Cipher b) Rail fence, row & Column Transformation.

Week 5:
Implement Blowfish algorithm.

Week 6:
Implement AES algorithm.

Week 7:
Implement RC4 algorithm.

Week 8:
Implement RSA algorithm.

Week 9:
Implement the Diffie-Hellman Key Exchange mechanism.

Week 10:
Calculate the message digest of a text using the SHA-1 algorithm.

Week 11:
Calculate the message digest of a text using the MD5.

Week 12:
Write a program in java, which performs a digital signature on a given text

Text Books:
1. Michael Gregg, Build Your Own Security Lab, Wiley India

Reference Books:
1. Cryptography and Network Security, Principles and Practices: William Stallings, 4th Edition Prentice hall.
2. Build Your Own Security Lab, Michael Gregg, Wiley India

Online Resources:
1. https://www.cybrary.it/catalog
2. http://cse.iitd.ernet.in/~murali/crypt
3. ttps://csrc.nist.gov/Projects/Block-Cipher-Techniques
4. https://www.udemy.com/build-your-own-cyber-lab-at-home
5. https://www.cyderaces.org/tutorials

Course Outcomes:
After completion of the course, students will be able to:
1. Implement various cipher techniques.
2. Implement various Cryptographic algorithms.
3. Implement various authentication techniques.
4. Understand and implement Key Exchange techniques.

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I Year M.Tech. CNIS II-Semester	**L**	**T**	**P**	**C**
	2	**-**	**-**	**-**

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) – samyukta varnaaha (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 (Sarvanaama shabdaaha) 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 (Ramaha Raamou Raamaaha) – Madhyama (twam Yuvaam Yooyam) – Uttama (Aham Aawaam Vayam).

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.

Reference Books:

1. Dr. Vishwas, "ABHYAAS PUSTAKAM", Samskrutha Bharati Publications, New Delhi.
2. Vempati Kutumba Shastri, Teach Yourself SANSKRIT, Prathama Deeksha by Rashtriya Sanskrit Sansthan, NewDelhi Publications.
3. Suresh Soni, "India's glorious Scientific Tradition", Ocean Books Pvt. Ltd., NewDelhi.

Course Outcomes:
Students 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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Department of Information Technology

I Year M.Tech. CNIS II-Semester

L	T	P	C
2	-	-	-

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.

Reference Books:

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

Course Outcomes:

Students 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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Department of Information Technology

I Year M.Tech. CNIS II-Semester

L	T	P	C
2	-	-	-

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.

Refernece Books:

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

Course Outcomes:

After learning the contents of this course, the student must 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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Department of Information Technology

I Year M.Tech. CNIS II-Semester

L	T	P	C
2	-	-	-

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 ach 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 and Vimla (1998) Yoga for Stress, London: Hamlyn.
5. Maguire and Imelda (92005) Yoga for a healthy body, London: Greenwich Editions.
6. Nagendra H.R. and Nagaratna.R 92004, Yoga prespective in stress management, Bangalore: Swami Vivekananda Yoga prakashan.
7. Nagendra H.R. and Nagaratna.R 92004, 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: Motilal Bandaridas 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://freevideolectures.com/course/3539/indian-philosophy/11

Course Outcomes:

After completion of the course the student will be able to

1. Enhancement of Physical strength and flexibility.
2. Learn to relax and focus.
3. Relieves physical and mental tension.
4. Improved work performance/ efficiency.

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Shaikpet, HYDERABAD - 500 104
Department of Information Technology

II Year M.Tech. CNIS - I Sem **L T P C**
3 - - 3

WIRELESS NETWORKS
(Program Specific Elective-5)

Prerequisites: Computer Networks.

Course Objectives:
1. Identify the principal components of telecommunications networks and key networking technologies.
2. Implement how the Internet and Internet technology works.
3. Identify the principal technologies and standards for wireless networking, communication, and Internet access.
4. Describe troubleshooting techniques for wireless networks.

UNIT 1: (~ 10 Lecture Hours**)**
Introduction: Applications, Location dependent services, Mobile and wireless devices, A short history of wireless communication, A market for mobile communications, Some open research topics, A simplified reference model, Wireless transmission, Frequencies for radio transmission, Signals, Antennas, Signal propagation, multiplexing, Modulation, Spread Spectrum, Cellular systems.

UNIT 2: (~ 8 Lecture Hours**)**
Medium access control: Motivation for a specialized MAC, SDMA, TDMA, FDMA
Characteristics of The Wireless Medium: Introduction, radio propagation mechanisms, path-loss modelling and signal coverage, effects of multi path and Doppler, channel measurement and modelling techniques.

UNIT 3: (~ 10 Lecture Hours**)**
Network Planning: Introduction, wireless network topologies, Cellular Topology, Cell Fundamentals, Signal-to-interference ratio calculation, capacity Expansion Techniques, network planning for CDMA systems,
Wireless Network Operation: Introduction, mobility management, radio resources and power management, security in wireless networks.

UNIT 4: (~ 10 Lecture Hours**)**
Wireless Application Protocol: Design and Principles of Operation, WAP Architecture & Components, WAE Overview, WAE Model, WTA Architecture, WTA Framework Components, WSP Specification, WTP Specification, WTLS Specification, WDP Specification.

UNIT 5: (~ 8 Lecture Hours**)**
Bluetooth: Design and Principles of Operation, Transmitter Characteristics, Bluetooth Security, Link Manager Protocol, Logical Link Control and Adaptation Layer Protocol, Alternatives to Bluetooth

Wireless Lans: Benefits of WLANs, Design and principles of Operation, WLAN Configurations, Microcells and Roaming, Types of WLANS, IEEE802.11

Text Books:

1. Jochen Schiller, "Mobile Communications", Addison-Wesley, 2nd Edition, 2004.
2. Kaveh Pahlavan and Prashant Krishnamurthy," Principles of Wireless Networks- a Unified approach", Pearson, 2004
3. Gary S.Rogers el al, "An Introduction to Wireless Technology", Pearson, 2007

Reference Books:

1. William Stallings, "Wireless communications and Networks", Pearson education, 2005, ISBN 81-7808-560-7
2. Jim Geier, "Wireless Networks first-step", Pearson, 2005.
3. Sumit Kasera et al, "2.5G Mobile Networks: GPRS and EDGE", TMH, 2008.
4. Matthew S.Gast, "802.11 Wireless Networks", O'Reilly, 2nd Edition, 2006.
5. Theodore s. Rappaport, "Wireless Communications ,principles and practice", 2nd Edition, PHI, 2002

Online Resources:

1. https://mva.microsoft.com/en-us/training-courses/networking-fundamentals-8249?l=zcmNgKKy_1704984382
2. http://www.brainkart.com/article/Wireless-Networks_9929
3. https://www.slideshare.net
4. https://www.udemy.com/wireless-networking-fundamentals
5. https://www.udemy.com/topic/wireless-networking
6. https://www.ed2go.com/courses/informationtechnology/networking/ilc/wireless-networking
7. https://alison.com/tag/computer-networking

Course Outcomes:

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

1. Learn to model radio signal propagation issues and analyze their impact on communication system performance.
2. Understand how the various signal processing and coding techniques combat channel uncertainties.
3. Understand the techniques of radio spectrum allocation in multi-user systems and their impact on networks capacity.
4. Introduce various wireless systems and standards and their basic operation cases

5. Learn to simulate wireless networks and analyze the simulation results

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Department of Information Technology

II Year M.Tech. CNIS - I Sem **L T P C**

3 - - 3

INTERNET OF THINGS

(Program Specific Elective-5)

Prerequisites: Programming language, Understanding of any processor architecture & instruction set.

Course Objectives:

1. Introduce the terminology, technology and its applications
2. Introduce the concept of M2M (machine to machine) with necessary protocols
3. Introduce the Python Scripting Language which is used in many IoT devices
4. Introduce the Raspberry PI platform, that is widely used in IoT applications
5. Introduce the implementation of web based services on IoT devices

UNIT 1: (~ 10 Lecture Hours**)**

Introduction to Internet of Things: Definition and Characteristics of IoT, Physical Design of IoT, IoT Protocols, IoT communication models, IoT Communication APIs.

IoT enabaled Technologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication protocols, Embedded Systems, IoT Levels and Templates

Domain Specific IoTs, Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle

UNIT 2: (~ 6 Lecture Hours**)**

IoT and M2M, Software defined networks, network function virtualization, difference between SDN and NFV for IoT

UNIT 3: (~ 10 Lecture Hours**)**

Introduction to Python - Language features of Python, Data types, data structures, Control of flow, functions, modules, packaging, file handling, data/time operations, classes, Exception handling Python packages - JSON, XML, HTTPLib, URLLib, SMTPLib.

UNIT 4: (~ 6 Lecture Hours**)**

IoT Physical Devices and Endpoints - Introduction to Raspberry PI-Interfaces (serial, SPI, I2C) Programming, Python program with Raspberry PI

with focus of interfacing external gadgets, controlling output, reading input from pins.

UNIT 5: (~ 13 Lecture Hours**)**

IoT Physical Servers and Cloud Offerings: Introduction to Cloud Storage models and communication APIs Web server, Web server for IoT, Cloud for IoT, Python web application framework designing a RESTful web API

Text Books:

1. Arshdeep Bahga and Vijay Madisetti, Internet of Things - A Hands-on Approach, Universities Press, 2015, ISBN: 9788173719547
2. Matt Richardson and Shawn Wallace, Getting Started with Raspberry Pi, O'Reilly (SPD), 2014, ISBN: 9789350239759

Reference Books:

1. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.
2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos and David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.

Online Resources:

1. https://www.theinternetofthings.eu
2. https://www.postscapes.com
3. https://onlinecourses.nptel.ac.in/noc17_cs22
4. https://www.udacity.com

Course Outcomes:

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

1. Understand the concepts of Internet of Things
2. Critical evaluation of IoT & M2M System through understanding of SDN and NFV
3. Learn basics of python programming language to program in IoT systems
4. Understanding the Raspberry Pi platform to develop IoT systems
5. Learn the implementation of web based services in IoT devices.

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Department of Information Technology

II Year M.Tech. CNIS - I Sem **L T P C**
3 - - 3

NETWORK SECURITY STANDARDS AND APPLICATIONS EVALUATION

(Program Specific Elective-5)

Prerequisites: Information Security, Computer networks

Course Objectives:

1. Compile, analyse, and assess the applicability of best practices in addressing information security issues relevant to the cyber security community.
2. Evaluate the impact of business constraints and processes on the implementation of network Security programs.
3. Integrate principles and techniques of risk analysis, project planning and change management in the development of network security strategies.
4. Demonstrate secondary research skills in the investigation and selection of best practice Solutions to address network security challenges.
5. Demonstrate mastery of theory, concepts and skills in addressing specialized aspects of network security Applications.

UNIT 1: (~ 9 Lecture Hours**)**
Introduction to Information Security: Introduction, Critical Characteristics, threats to information Security, Attacks on Information Security, Security Professionals and the Organization, Information Security Policies, Standards and Practices, Frameworks for Industry Standards in Information Security.

UNIT 2: (~10 Lecture Hours**)**
Auditing, Monitoring, and Logging: Monitoring Network Systems, Configuration and Change Management, Introduction to security audits, need for security audits, organizational roles, Auditor's roles, Types of security audits, Audit approaches, Technology based audits, Auditing (Formal Reviews), Systems Certification, Accreditation and Authorization.

UNIT 3: (~ 10 Lecture Hours**)**
Contingency Planning and Networking Incident Response: Introduction, Contingency Planning, Incident Response Plan.
Network Authentication and Remote Access Using VPN: Introduction, Access Control, Virtual Private Networks.

UNIT 4: (~ 8 Lecture Hours**)**
Network Monitoring and Intrusion Detection and Prevention Systems: Introduction, Network monitoring Software: Packet Sniffing, intrusion Detection and Prevention Systems, Honey pots and Honey nets.
UNIT 5: (~ 8 Lecture Hours**)**
Wireless Network Security: Introduction, Wireless Technologies and Standards, Wireless Architectures and Topologies, Wireless Security Protocols, WLAN Security Concerns, Bluetooth.

Text Books:

1. Michael Whitman, Herb Mattord and David Mackey, Guide to Network Security, Andrew Green Cengage Learinng.
2. Nina Godbole, Information Systems Security, Wiley India, 2009

Reference Books:

1. Michael E. Whitman and Herbert J. Mattord, Principles and Practices of Information Security. Cengage Learning,

Online Resources:

1. Microsoft Security Risk Management Guide
2. Risk Management Guide for Information Technology Systems http://csrc.nist.gov/publications/nistpubs/800-30/sp800-30.pdf
3. OCTAVE approach http://www.cert.org/octave
4. COBIT http://www.isaca.org
5. Guide to Firewalls and Policies (UNIT 3) Http://csrc.nist.gov/publications/nistpubs/ 800-41/sp800-41.pdF
6. Firewalls and Network Security, Micheal E.Whitman, et al. Cengage Learning, 2008
7. Audit Trails (UNIT 7) http://csrc.nist.gov/publications/nistpubs/800-12/800-12- html/chapter18.html
8. Information Security Management Handook, Harold F. Tipton, CRC Press, 2012
9. Information Security Policies and Procedures, 2nd Edition, Thomas R. Peltier, Auerbach, 2004.
10. https://www.coursera.org
11. https://www.learningtree.com

Course Outcomes:

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

1. Identify Security attacks and Systems management.
2. Acquire good knowledge on Security Auditing and Approaches.
3. Explain about Access control mechanism and Security tools.
4. Apply networking and security skills to industrial need.
5. Understanding Organizational network security related issues and Mitigating Mechanisms.
6. Summarize the various Application areas of wireless devices.

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Department of Information Technology

II Year M.Tech. CNIS - I Sem **L T P C**
3 - - 3

BUSINESS ANALYTICS
(Open Elective -1)

Prerequisites: ---

Course Objectives:
1. To understand the role of business analytics within an organization.
2. To gain and 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, ensuing 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. Business Analytics for Managers: Taking Business Intelligence Beyond Reporting – wiley Publication: Gert H.N. Laursen, Jesper Thorlund, Wiley Pub 2nd Edition.
2. Business Analytics: Data Analysis & Decision Making, Al bright /Winston, Cengage Learning Publications, 5th Edition.

Reference Books:

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

Online Resources:

1. http://nptel.ac.in/courses/110105089/

Course Outcomes:

After learning the contents of this course, the student must be able to

1. 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 modelling 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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(AUTONOMOUS)
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Department of Information Technology

II Year M.Tech. CNIS - I Sem

L	T	P	C
3	-	-	3

INDUSTRIAL SAFETY

(Open Elective -1)

Prerequisites: ---

Course Objectives:

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 firefighting equipment's 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 Boks:

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

Reference Books:

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

Online Resources:

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. Assess 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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(For Women)
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Department of Information Technology

II Year M.Tech. CNIS - I Sem

L	T	P	C
3	-	-	3

Operations Research
(Open Elective -1)

Prerequisites: ---

Course objectives:
The course will enable the students to:
1. Study the linear programming and nonlinear 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 –poison 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, Kedarnnath, Ramnath & Co., Meerut, 2009.
4. V.K. Kapoor, Operations Research", S. Chand Publishers, New Delhi, 2004.

Online Resources:
1. IOR Tutorials (Interactive Operations Research Tutorial)

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 nonlinear 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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(For Women)

(AUTONOMOUS)
Shaikpet, HYDERABAD - 500 104
Department of Information Technology

II Year M.Tech. CNIS I-Semester

L	T	P	C
3	-	-	3

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 McGraw 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. http://nptel.ac.in/courses/110101004/24

Course Outcomes:

After learning the contents of this course, the student must 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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(For Women)
(AUTONOMOUS)
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Department of Information Technology

II Year M.Tech.CNIS I-Semester

L	T	P	C
3	-	-	3

COMPOSITE MATERIALS

(Open Elective -1)

Prerequisites: Basic understanding of materials and mechanical properties.

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 play 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, John Wiley & Sons, NY, Materials Science and Engineering, An introduction, Indian Edition, 2007.

Reference Books:

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

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

Course Outcomes:

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

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(For Women)
(AUTONOMOUS)
Shaikpet, HYDERABAD - 500 104
Department of Information Technology

II Year M.Tech. CNIS I-Semester

L	T	P	C
3	-	-	3

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 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.

G. NARAYANAMMA INSTITUTE OF TECHNOLOGY & SCIENCE
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Department of Information Technology

II Year M.Tech. CNIS I-Semester	**L**	**T**	**P**	**C**
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POWER FROM RENEWABLE ENERGY SOURCES

(Open Elective -1)

Prerequisites: ---

Course Objectives:

- To introduce various types of renewable energy technologies
- 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: (~ 08 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: (~ 08 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: (~ 09 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: (~ 09 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.