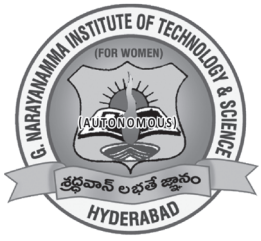
ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS

DIGITAL ELECTRONICS AND COMMUNICATION ENGINEERING

FOR

M.TECH TWO YEAR DEGREE COURSE

(Applicable for the batches admitted from 2022-2023)



G. Narayanamma Institute of Technology and Science

(for women)

(AUTONOMOUS)

Shaikpet, Hyderabad –500104. T.S.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

DEPARTMENT VISION

ECE department envisions to develop high quality and technically competent women engineers who can address the growing challenges in the modern world with a keen sense of social responsibility.

DEPARTMENT MISSION

- Knowledge Based Engineering Education
- Analysis and Design Skills with Modelling Potential, Technical Competence
- Industry Compatibility and Women Empowerment with Societal Commitment
- Professional Career Growth with Values and Ethics

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

ACADEMIC REGULATIONS (R22)
for CBCS Based M.Tech. Degree Programme (Regular/Full Time PG Course) in

DIGITAL ELECTRONICS AND COMMUNICATION ENGINEERING
(ELECTRONICS AND COMMUNICATION ENGINEERING DEPARTMENT)
(Effective for the students admitted into I year from the
Academic Year 2022-23and onwards)

1.0 Post-Graduate Degree Programme (PGDP) 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 Programmes under Choice Based Credit System (CBCS), with effect from the Academic Year 2022 - 23 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 **PGDP** 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 Programme 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 PGDP - Academic Regulations/Norms.

3.2.1 Semester Scheme:

Each M.Tech. Degree Programme is of 2 Academic Years (4 Semesters) with each academic year divided into two Semesters of ~ 22 weeks (≥ 90 working days) each, and each semester has - 'Continuous Internal Evaluation (CIE)' and 'End Semester Examination or Semester End Examination (SEE)'. Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) as denoted and suggested by UGC and AICTE are taken as 'references' for the present set of Regulations. The terms 'SUBJECT' or 'COURSE' imply the same meaning here, and refer to 'Theory Subject', or 'Lab/Practical Course', or 'Elective (Program Specific Elective/ Open Elective)', or 'Mini-Project', or '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**racticalsPeriods:**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.
- Audit Courses shall not carry any Credits.

3.2.3 Subject/ Course Classification:

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

(a) Core Courses (CoC), and

(b) Elective Courses (E*l*C)

Core Courses (CoC) and Elective Courses (E*l*C) are categorized as PS (Professional Subjects), which are further subdivided as –

(i) PC (Professional/ Departmental Core) Courses

(ii) PSE (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 (AC - 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.	**18**
2)	**Elective Courses (E*l*C)**	**PSE – Program Specific Elective**	Includes Elective subjects related to the Parent Department/ Branch of Engg.	**15**
		OE - Open Elective	Elective Courses which include subjects from other technical and/or Emerging Areas	**3**
3)	**Project Related Courses**	**PW - Project Work**	M.Tech. Project or PG Project or PG Major Project (Phase-I and Phase-II)	**26**
		Mini-Project (MP)	Mini-Project over 1 semester duration	**2**
		Seminar	Seminar based on core contents related to the Parent Department/ Branch of Engg. in identified specialization	**2**
4)	Prescribed Course	**AICTE Model Curriculum 2018**	Research Methodology & IPR	**2**
5)	Audit Courses	**AC – as per AICTE Model Curriculum 2018**	Inclusive of AICTE Suggested List	**No Credits**
Total Credits for PGDP (For the Specializations Listed)				**68**

4.0 Course Work

4.1 A student, after securing admission, shall pursue and complete the M.Tech. Degree Programme 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 Programme and Award of the M.Tech. Degree in the respective Branch of Engineering with the chosen Specialization.

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

5.0 Course Registration

5.1 A 'Faculty Advisor' shall be assigned to each M.Tech. Degree Programme 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 Programme 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 Thechoice for the 'Additional Subjects/ Courses' in the I Year (in any semester, above the typical 18 Credit norm, and within the Maximum Permissible Limit of 21 Credits, as applicable) must be indicated clearly in the ONLINE Registration, which needs the specific approval and the signature of the Faculty Advisor/Counsellor assigned and the Head of the Department on the hard-copy.

5.6 If the student submits ambiguous choices or multiple options or erroneous entries during ONLINE Registration for the Subject(s)/Course(s) under a given/specified Course Group/Category as listed in the Course Structure for that particular PGDP 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 12 (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 studentshall 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, 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 (24 out of 60 marks)in the Semester End Examination (SEE),
- 40% marks in the Internal Examinations (16 out of 40 marks allotted foe CIE) 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/ Seminars, 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 submit the report) as specified by the Supervisor, or (ii) does not present the Seminars as required, or (ii)

secures less than 50% of Marks (< 50 marks) in evaluations. She may reappear once for each of the 'Mini-Project/ Seminars' evaluations, as and when they are 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 they are 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 (i.e., CGPA at the end of PGDP is to be ≥5.0), to successfully complete the PGDP. **THERE IS NO EXEMPTION OF CREDITS IN ANY CASE**

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 some more 'extra Subjects' (in the parent Department or other Departments/ Branches of Engg.) other than those listed Subjects totalling to 68 Credits as specified in the Course Structure, the performances in those 'extra Subjects' (although evaluated and graded using the same procedure as that of the required 68 Credits) shall not be taken into account while calculating the SGPA and CGPA. For such 'extra Subjects' registered, the Letter Grade alone shall be indicated in the Grade Card as a performance measure, subject to the completion of the Attendance and Academic Requirements as stated in Clauses 7.0 and 8.1 – 8.4 above.

8.6 The students who fail 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 their I Year, shall forfeit their seats in M.Tech. Programme, and their admissions 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 (ESE) 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 will 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, or Seminar 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 40% CIE and 60% 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: 40 marks for CIE (Continuous Internal Evaluation), and 60 marks for the SEE (Semester End Examination).

9.3 **a)** In CIE, for theory subjects, during a semester, there shall be two mid-term examinations. Each Mid-Term examination consists of two parts i) **Part – A** for 10 marks, ii) **Part – B** for 20 marks with a total duration of 2 hours as follows:

1. Mid-Term Examination for 30 marks:
   a. Part - A: Objective/quiz paper for 10 marks.
   b. Part – B: Descriptive paper for 20 marks.

   The objective/quiz paper is set with 10 questions for a total of 10 marks. The descriptive paper shall contain 6 full questions out of which, the student has to answer 4 questions, each carrying 5 marks. The average of the two Mid Term Examinations shall be taken as the final marks for Mid Term Examination (for 30 marks). The remaining 10 marks of Continuous Internal Assessment (out of 40) are distributed as:
2. Assignment for 5 marks. (Average of 2 Assignments each for 5 marks)
3. Subject Viva-Voce/PPT/Poster Presentation/ Case Study on a topic in the concerned subject for 5 marks.

   While the first mid-term examination shall be conducted on 50% of the syllabus, the second mid-term examination shall be conducted on the remaining 50% of the syllabus.

   Five (5) marks are allocated for assignments (as specified by the subject teacher concerned). The first assignment should be submitted before the conduct of the first mid-term examination, and the second assignment should be submitted before the conduct of the second mid-term examination. The average of the two assignments shall be taken as the final marks for assignment (for 5 marks).

   Subject Viva-Voce/PPT/Poster Presentation/ Case Study on a topic in the concerned subject for 5 marks before II Mid-Term Examination.

- The Student, in each subject, shall have to earn 40% of marks (i.e. 16 marks out of 40 marks) in CIE, 40% of marks (i.e. 24 marks out of 60) in SEE and Overall 50% of marks (i.e. 50 marks out of 100 marks) both CIE and SEE marks taking together.
- *The student is eligible to write Semester End Examination of the concerned subject, if the student scores ≥ 40% (16 marks) of 40 Continuous Internal Examination (CIE) marks.*
- *In case, the student appears for Semester End Examination (SEE) of the concerned subject but not scored minimum 40% of CIE marks (16 marks out of 40 internal marks), his performance in that subject in SEE shall stand cancelled inspite of appearing the SEE.*

b) 60 marks are allocated for Semester End Examination (SEE), which is of 3 hours duration. The SEE Question Paper will have two parts: Part-A is for 10 marks and is compulsory - it consists of 10 questions of 1 mark each (2 questions from each unit) and Part-B is for 50 marks – it consists of 5 questions of 10 marks each, for each question there will be 'either/ or' choice, which means that there will be two questions from each unit and the student should answer one of these two.

9.4 For the Lab./Practical Subjects, there shall be a Continuous Internal Evaluation (CIE) during the semester for 40 marks, and Semester End Examination (SEE) at the end of the semester for 60

marks. Out of the 40 marks for Internals, day-to-day work assessment in the laboratory shall be evaluated for 20 marks; the performance in an Internal Lab./Practical Test (10 marks) and viva-voce (10 marks) shall be evaluated for a total of 20 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.

The Student, in each subject, shall have to earn 40% of marks (i.e. 16 marks out of 40 marks) in CIE, 40% of marks (i.e. 24 marks out of 60) in SEE and Overall 50% of marks (i.e. 50 marks out of 100 marks) both CIE and SEE marks taking together.

The student is eligible to write Semester End Examination of the concerned subject, if the student scores ≥40% (16 marks) of 40 Continuous Internal Examination (CIE) marks.

In case, the student appears for Semester End Examination (SEE) of the concerned subject but not scored minimum 40% of CIE marks (16 marks out of 40 internal marks), his performance in that subject in SEE shall stand cancelled inspite of appearing the SEE

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 40 marks, and SEE shall be for 60 marks. Marks earned under CIE for the 'Mini-Project' 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, and the 'Mini-Project' shall be evaluated by the Committee for 60 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' shall be included in the I Year II Semester Grade Card.

9.6 **Electives:** 5 Program Specific Elective (PSE) Courses and 1 Open Elective (OE) Course are offered in the 4 Semester PG Degree Programme 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 There shall be Seminar Presentations in the I Year, I and II Semesters. For the Seminar, the student shall collect the information on a technical topic, prepare a Technical Report and submit the Technical Report to the Department at the time of Seminar Presentation. Each Seminar Presentation (along with the Technical Report submitted) shall be evaluated for 100 marks by Two Faculty Members assigned by the Head of the Department. There shall be no SEE or external examination for the Seminar.

9.8 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 considerations and evaluations.

d) 100 marks are allocated for each Phase (Phase-I and Phase-II) of the Project Work, out of which 40 marks shall be for CIE (Continuous Internal Evaluation/CIE), and 60 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 plagiarism content to be below the specified level of 30%, 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, Seminars 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 60 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 (with in 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, or 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 Points (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'. If a student fails to appear for SEE of any Subject (s) for any reason whatsoever, she is deemed to have 'failed', and she will get F Grade in all such failed Subject (s). She 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 got '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 theGrade 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 (SCP) 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

$$\textbf{SGPA} = \{ \sum_{i=1}^{N} C_i G_i \} / \{ \sum_{i=1}^{N} C_i \} \quad \textbf{.... For each semester},$$

where 'i' is the Subject indicator index (takes into account all Subjects in a Semester), 'N' is the no. of Subjects 'REGISTERED' for the Semester, C_i is the no. of Credits allotted to the i^{th} Subject,

and G_j represents the Grade Points (GP) corresponding to the Letter Grade awarded for that i^{th} Subject.

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

$$\textbf{CGPA} = \{ \sum_{j=1}^{M} C_j G_j \} / \{ \sum_{j=1}^{M} C_j \} \quad \textbf{.... For all S Semesters registered}$$

(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), C_i is the no. of Credits allotted to the j^{th} Subject, and G_j represents the Grade Points (GP) corresponding to the Letter Grade awarded for that j^{th} Subject. After Registration and completion of the I Year I Semester however, the SGPA of that Semester itself may be taken as CGPA, as there are no cumulative effects.

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

11.11 For the calculations listed in Clauses 11.6 – 11.10, performance in the failed Subjects/ Courses (securing F Grade) shall also be taken into account, and the Credits of such Subjects/Courses shall also be included in the multiplications and summations.

11.12 Passing Standards:

a) A Student shall be declared successful or 'passed' in a semester, only when she gets a SGPA ≥ 5.00 (at the end of that particular Semester); and a student shall be declared successful or 'passed' in the entire PGDP, 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 PGDP), 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 = (final CGPA - 0.5) 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 (PGDP), and secures the required number of 68 Credits (with CGPA ≥ 5.0), within the 4 Academic Years from the Date of Commencement of the First Academic Year, shall be declared to have 'QUALIFIED' for the Award of the M.Tech. Degree in the chosen Branch of Engineering, with the Specialization considered at the time of Admission.

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

AWARD OF CLASS BASED ON FINAL CGPA (at the end of the PG Programme)

First Class with Distinction	Final CGPA 8.00 or more*
First Class	Final CGPA below 8.00 but not less than 7.00
Second Class	Final CGPA below 7.00 but not less than 6.00
Pass Class	Final CGPA below 6.00 but not less than 5.00

*** Note :**

a) A student with Final CGPA (at the end of the PG Degree Programme) ≥ 8.00, and fulfilling the following conditions -

(i) should have passed all the Subjects/ Courses within the first 2 Academic Years (or 4 Sequential Semesters) from the Date of Commencement of her First Academic Year,

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

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

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

13.3 A student with Final CGPA (at the end of the PG Degree Programme) < 5.00 will not be eligible for the Award of the Degree.

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 Programme after the PGDP period of 2 years, may be considered eligible for readmission - to the same PGDP 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.

MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

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

4.	Smuggles in the answer book , 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 chiefsuperintendent/assistant –superintendent / any officer on duty or misbehaves or creates disturbance of anykind 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, eitherspoken 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 tendencyto 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 alreadyappeared 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 andcancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations andproject 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 university for further action to award suitable punishment.	

M.Tech. 2 Year (4 Semesters) Regular Programme in
DIGITAL ELECTRONICS AND COMMUNICATION ENGINEERING(DECE)
Department of Electronics & Communication Engineering
COURSE STRUCTURE
(Applicable for the Batches admitted from the Academic year 2022-23)

I Year I Semester

S.No.	Group	Subject Code	Subject	L	T	P	Credits
1)	PC	521BA	Digital System Design with FPGA	3	0	0	3
2)	PC	521BB	Advanced Wireless Communications	3	0	0	3
3)	PSE1		**Program Specific Elective - 1**	3	0	0	3
		521BC	CMOS Digital VLSI Design				
		521BD	Advanced Computer Architecture				
		521BE	Real Time Operating Systems				
4)	PSE2		**Program Specific Elective - 2**	3	0	0	3
		521BF	Advanced Digital Signal Processing				
		521BG	Mobile Computing				
		521BH	Coding Theory and Techniques				
5)	PC	52115	Digital System Design Lab	0	0	3	1.5
6)	PC	52116	Advanced Wireless Communications Lab	0	0	3	1.5
7)	PW	521BJ	Research Methodology and IPR	2	0	0	2
8)	PW	52117	Seminar - 1	0	0	2	1
9)	AC1	52118	Audit Course - 1	2	0	0	-
			TOTAL CREDITS				18

I Year II Semester

S.No.	Group	Subject Code	Subject	L	T	P	Credits
1)	PC	522BK	ARM Microcontrollers and Programmable Digital Signal Processors	3	0	0	3
2)	PC	522BL	Advanced Communication Networks	3	0	0	3
3)	PSE3		**Program Specific Elective – 3**	3	0	0	3
		522BM	Computer Vision				
		522BN	Low power CMOS VLSI Design				
		522BP	Design of Fault Tolerant Systems				
4)	PSE4		**Program Specific Elective - 4**	3	0	0	3
		522BQ	Communication and Networking Technologies for IoT				
		522BR	Principles of Artificial Intelligence and Machine Learning				
		522BS	Adhoc and Wireless Sensor Networks				
5)	PC	52219	ARM Microcontrollers and Programmable Digital Signal Processors Lab	0	0	3	1.5
6)	PC	52220	Advanced Communication Networks Lab	0	0	3	1.5
7)	PW	52221	Mini Project	0	0	4	2
8)	PW	52222	Seminar - 2	0	0	2	1
9)	AC2	52223	Audit Course - 2	2	0	0	-
			TOTAL CREDITS				18

M.Tech. 2 Year (4 Semesters) Regular Programme in
DIGITAL ELECTRONICS AND COMMUNICATION ENGINEERING(DECE)
Department of Electronics &Communication Engineering
COURSE STRUCTURE

II Year I Semester

S.No.	Group	Subject Code	Subject	L	T	P	Credits
1)	PSE5		**Program Specific Elective – 5**	3	0	0	3
		523BT	MIMO Systems				
		523BU	System on Chip Architecture				
		523BV	Embedded Networking				
2)	OE		**Open Elective**	3	0	0	3
3)	PW	52324	Project / Dissertation (Phase – I)	0	0	20	10
			TOTAL CREDITS				16

II Year II Semester

S.No.	Group	Subject Code	Subject	L	T	P	Credits
1)	PW	52425	Project / Dissertation (Phase – II)	0	0	32	16
			TOTAL CREDITS				16

AUDIT COURSES

1) English for Research Paper Writing-521HA/522HA
2) Disaster Management-521HB/522HB
3) SANSKRIT for Technical Knowledge-521HC/522HC
4) Value Education-521HD/522HD
5) Constitution of India-521HE/522HE
6) Pedagogy Studies-521HF/522HF
7) Stress Management by YOGA-521HG/522HG
8) Personality Development through Life Enlightenment Skills-521HH/522HH

OPEN ELECTIVES :

1) Business Analytics—523GA
2) Industrial Safety—523GB
3) Operations Research—523GC
4) Cost Management of Engineering Projects—523GD
5) Composite Materials—523GE
6) Energy from Waste—523GF
7) Power from Renewable Energy Sources. —523GG

M.Tech. I Year, I Sem **L T P C**
Course Code:PC521BA **3 0 0 3**

DIGITAL SYSTEM DESIGN WITH FPGA (PC-1)

Prerequisites: 1. Digital System Design.

Course Objectives:

1. To Understand the Basics Modeling Concepts of Verilog HDL.
2. To Provide an Overview of System Design Approach using Programmable Logic Devices.
3. To Learn the Commercially Available and Techniques of CPLDs & FPGAs.
4. To get Exposed to the Various Architectural Features of CPLDs and FPGAs.
5. To Implement the Sequential Circuits on CPLDs and FPGAs using CAD Tools.
6. To Provide Extended Knowledge of Digital Logic Circuits in the Form of State Table and State Model Approach.

UNIT 1: (~8 Lecture Hours)

Verilog HDL Coding Style: Overview of Digital Design with Verilog HDL, Hierarchical Modeling Concepts, Basic Concepts of Modules and Ports, Gate Level Modeling, Dataflow Modeling, Behavioral Modeling, Tasks and Functions, Useful Modeling Techniques.

UNIT 2: (~12 Lecture Hours)

Programmable Logic Devices: The Concept of Programmable Logic Devices, SPLDs, PAL Devices, PLA Devices, GAL Devices, CPLD Architecture, Xilinx CPLDs, Altera CPLDs, FPGAs-FPGA Architecture, Vertex CLB and Slice- Stratix LAB and ALM-RAM Blocks, DSP Blocks, Clock Management, I/O Standards, Additional Features.

UNIT 3: (~8 Lecture Hours)

FPGAs/CPLDs: FPGAs/CPLDs Programming Technologies, Commercially Available FPGAs, Xilinx's Vertex and Spartan, Actel's FPGA, Altera's FPGAs/CPLDs.

UNIT 4: (~ 10 Lecture Hours)

Sequential Circuit Design: Design Procedure for Sequential Circuits, Design Example, Code Converter, Design of Iterative Circuits, Design of a Comparator, Design of Sequential Circuits using ROMs and PLAs, Sequential Circuit Design using CPLDs, Sequential Circuit Design using FPGAs, Simulation and Testing of Sequential Circuits, Overview of Computer aided Design.

UNIT 5: (~ 9 Lecture Hours)

Analysis and Derivation of Clocked Sequential Circuits with State Graphs and Tables: A Sequential Parity Checker, Analysis by Signal Tracing and Timing Charts-State Tables and Graphs-General Models for Sequential Circuits, Design of a Sequence Detector, more Complex Design Problems, Guidelines for Construction of State Graphs, Serial Data Code Conversion, Alphanumeric State Graph Notation.

Text Books:

1. Volnei A. Pedroni, "Digital Electronics and Design with VHDL"- Elsevier publications 1st Edition ,2008.
2. John V. Old Field, Richard C. Dorf, "Field Programmable Gate Arrays", Wiley, 2008.
3. Charles H. Roth, Jr. "Fundamentals of Logic Design" -Enhanced 7th Edition 2020.

Reference Books:

1. Samir Palnitkar, "Verilog HDL, A Guide to Digital Design and Synthesis" Prentice Hall, 2nd Edition, 2003.
2. S. Ramachandran, "Digital VLSI System Design", A Design Manual for Implementation of Projects on FPGAs and ASICs Using Verilog" Springer Publication, 1st Edition, 2007.
3. Wayne Wolf, "FPGA Based System Design", Prentices Hall Modern Semiconductor Design Series 2004.
4. Digital System Design using Programmable Logic Devices- Parag K. Lala, BS Publications 2003.

Online Resources:

1. https://nptel.ac.in/courses/117108040 (Course Title: Digital System Design with PLDs and FPGAs, Prof. Kuruvilla Varghese IISc Bangalore)
2. https://onlinecourses.nptel.ac.in/noc22_ee110/preview(Course Title: Digital Circuits, Prof. Santanu Chattopadhyay IIT Kharagpur)

Course Outcomes (COs)

After completion of the course the student should be able to

CO1 Apply the Verilog HDL Concepts for Digital Circuits.

CO2 Narrate the Concepts of ROMs, PALs, PLAs CPLDs and FPGAs.

CO3 Design and Develop Different Sequential Circuits.

CO4 Implement Sequential Circuit Design using FPGAs/CPLDs.

CO5 Analyze the Clocked Sequential Circuits with State Graphs and State Tables.

❄ ❄ ❄

M.Tech. I Year, I Sem **L T P C**
Course Code: PC521BB **3 0 0 3**

ADVANCED WIRELESS COMMUNICATIONS

Prerequisites: Cellular Mobile Communications

Course Objectives:

1. Discuss about the cellular system fundamentals and Handoff Strategies.
2. Understand the impact of fading effects on the performance communication system.
3. Discuss and derive the capacity of AWGN and MIMO channels.
4. Discuss fundamentals of Equalization in a communication Receiver.
5. Understand the basics Software defined radio.

UNIT 1: (~8 Lecture Hours)

Cellular Communication Fundamentals: Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interference and system capacity, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems–cell splitting, sectoring, Comparison of 1G, 2G, 3G & 4G.

UNIT 2: (~8 Lecture Hours)

FADING CHANNELS AND DIVERSITY TECHNIQUES: Wireless channels – Error/Outage probability over fading channels – Diversity techniques – Channel coding as a means of time diversity – Multiple antennas in wireless communications.

UNIT 3: (~10 Lecture Hours)

CAPACITY & INFORMATION RATES OF MIMO CHANNELS: Capacity and Information rates of noisy, AWGN and fading channels – Capacity of MIMO channels – Capacity of non-coherent MIMO channels – Constrained signalling for MIMO communications.

UNIT 4: (~12 Lecture Hours)

Equalization: Fundamentals of Equalization, Training a Generic Adaptive Equalizer, Equalizers in a communications receiver, classification of equalization techniques. Linear Equalizers, Nonlinear Equalization, Algorithms for adaptive equalization.

CDMA: CDMA Digital Cellular Standard (IS-95), Forward CDMA Channel, Reverse CDMA Channel.

OFDM-Basic principles, Block diagram and Mathematical representation

UNIT 5: (~10 Lecture Hours)

Introduction to Software Radios: Need for Software Radio, Characteristics and benefits of software radio- Design Principles of Software Radio, RF Implementation issues- The Purpose of RF Front – End, Dynamic Range- The Principal Challenge of Receiver Design – RF Receiver Front- End Topologies- Enhanced Flexibility of the RF Chain with Software Radios- Importance of the Components to Overall Performance- Transmitter Architectures and Their Issues- Noise and Distortion in the RF Chain, ADC and DAC Distortion.

Text Books:

1. T.S.Rappaport, "Wireless Communications, Principles and Practice", 2nd edition, PHI, 2010.
2. William C.Y.Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", 2nd edition, TMH, 2006.
3. UpenaDalal, "Wireless Communication", Oxford University Press, 8th Impression, 2015.
4. Aditya K Jagannatham, "Principles of Modern Wireless Communication Systems Theory and Practice", McGraw Hill India, 2015.
5. Markus Dillinger, Kambiz Madani, "Software Defined Radio Architecture System and Functions", WILEY 2003

Reference Books:

1. KavehPahLaven and P. Krishna Murthy," Principles of Wireless Networks-, Pearson Education, 2006.
2. V.K.Garg, J.E.Wilkes, "Principle and Application of GSM", Pearson Education, 5th edition, 2008.
3. V.K.Garg, "IS-95 CDMA & CDMA 2000", Pearson Education, 4th edition, 2009.
4. Mischa Schwartz, "Mobile wireless communications", Cambridge university press,2013.
5. Walter Tuttle Bee, "Software Defined Radio: Enabling Technologies", 2002, WileyPublications.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_ee78/preview(Basics of software defined Radios by Prof. Meenakshi Rawat, IIT Roorkee)
2. http://nptel.ac.in/courses/117104099/Advanced 3G and 4G Wireless Mobile Communications

Course Outcomes(COs)

After completion of the course the student should be able to

CO1 Introduce the concepts and techniques associated with Wireless Cellular Communication systems.

CO2 Summarize and analyze fading effects and diversity techniques.

CO3 Illustrate and evaluate the capacity of AWGN and MIMO channels.

CO4 To distinguish the equalization techniques.

CO5 Analyze and design CDMA and OFDM system functioning.

CO6 Illustrate transceiver elements of Software defined radio.

❄ ❄ ❄

M.Tech. I Year, I Sem **L T P C**
Course Code: 521BC **3 0 0 3**

CMOS DIGITAL VLSI DESIGN
(Professional Elective-1)

Prerequisites : Digital System Design

Course Objectives:

1. To Understand the Basic Concepts of MOS Structure.
2. To Demonstrate the General Characteristics of MOS Transistor and CMOS Inverter.
3. To Estimate the Quality Metrics of a Digital Design.
4. To Design and Develop Combinational and Sequential Circuits.

UNIT 1: (~8 Lecture Hours)
Review: Basic MOS structure and its static behavior.
Quality Metrics of a Digital Design: Cost, Functionality, Robustness, Power, and Delay, MOS Transistor Basic, MOS Parasitic & SPICE Model;wire delay models of MOS transistors.

UNIT 2: (~8 Lecture Hours)
CMOS Inverter: Static CMOS inverter, switching threshold and noise margin concepts and their evaluation, Dynamic behavior, Power consumption and Analyzing Power Consumption using SPICE.

UNIT 3: (~10 Lecture Hours)
Combinational Logic: Static CMOS design, Logic effort, Ratioed logic, Pass transistor logic, Dynamic logic, Speed and power dissipation in dynamic logic, Cascading dynamic gates, CMOS transmission gate logic.

UNIT 4: (~12 Lecture Hours)
Sequential Logic: Static latches and registers, Bi-stability principle, MUX based latches, Static SR flip-flops, Master-slave edge-triggered register, Dynamic latches and registers, Concept of pipelining, Pulse registers, and Non-Bi stable sequential circuit.
Advanced Technologies: Giga-scale dilemma, Short channel effects, High–k, Metal Gate Technology, FinFET and TFET .

UNIT 5: (~8 Lecture Hours)
Physical Design Flow: Floor planning, Placement, Routing, CTS, Power analysis and IR drop estimation-static and dynamic, ESD protection-human body model, Machine model.
Designing Memory & Array structures: SRAM and DRAM Memory Core - memory peripheral circuitry - Memory reliability and yield - Power dissipation in memories.

Text Books :

1. J.P.Rabaey, A.P.Chandrakaran, B.Nikolic, "Digital Integrated Circuits: A design Perspective", Prentice Hall Electronics & VLSI series, 2nd Edition, 2008.
2. Pucknell, D.A. and Eshraghian, K., "Basic VLSI Design", PHI, 3rd Edition, 2012.

Reference Books:

1. Baker, Li, Boyce, "CMOS Circuit Design, Layout, and Simulation", 2nd Edition.Wiley.
2. R. J. Baker, "CMOS circuit Design, Layout and Simulation", IEEE Inc., 2008.
3. Kang. S and Leblebici .Y, "CMOS Digital Integrated Circuits, Analysis and Design", 3rd Edition, TMH.

Online Resources:

1. https://www.digimat.in/nptel/courses/video/117101004/L02.html (Course Title:Advanced VLSI Design By Prof.A.N.Chandorkar,IIT Bombay)
2. https://nptel.ac.in/courses/108107129(Course Title:CMOS Digital VLSI Design,By Prof.Sudeb Dasgupta,IIT Roorke)

Course Outcomes(COs)

After completion of the course the student should be able to

CO1 Recall the Concepts of Basic MOS Structure and its Static Behavior.

CO2 Explain the Quality Metrics of a Digital Design.

CO3 Discuss Physical Design flow and Advanced Technologies.

CO4 Design Different Types of Logic Gates using CMOS Inverter and Analyze their Transfer Characteristics.

CO5 Design Combinational, Sequential and Memory circuits and Applying the Knowledge of Digital Design, to Build Complex Digital Circuits.

CO6 Analyze Power Dissipation and Delays in Combinational Sequential and Memory Circuits.

❄ ❄ ❄

M. Tech. I Year, I Sem. **L T P C**
Course Code: 521BD **3 0 0 3**

ADVANCED COMPUTER ARCHITECTURE
(Program Specific Elective-1)

Prerequisites: 1. Computer Organization

Course Objectives:

1. To discuss about the computer architecture with the underlying design principles.
2. To understand the impact of pipelining and parallel processing on computer performance.
3. To study the methodology of processor and control design.
4. To describe memory organization, system organization, and parallel processing.

UNIT 1: (~7 Lecture Hours)

Parallel Processing and Pipelining Processing: Architectural Classification, Applications of Parallel Processing, Instruction Level Parallelism and Thread Level Parallelism, Explicitly Parallel Instruction Computing (EPIC) Architecture.

UNIT 2: (~10 Lecture Hours)

Pipeline Architecture: Principles and Implementation of Pipelining, Classification of Pipelining Processors, Design aspect of Arithmetic and Instruction Pipelining, Pipelining Hazards and Resolving Techniques, Data buffering techniques, Advanced Pipelining Techniques, Software Pipelining, VLIW (Very Long Instruction Word) processor.

UNIT 3: (~8 Lecture Hours)

Vector and Array Processor: Issues in Vector Processing, Vector Performance Modeling, SIMD Computer Organization, Static Vs Dynamic Network, Parallel Algorithms for Array Processors-Matrix Multiplication.

UNIT 4: (~10 Lecture Hours)

Multiprocessor Architecture: Loosely and Tightly Coupled Multiprocessors, Inter Processor Communication Network, Time Shared Bus, Multiport Memory Model, Memory Contention and Arbitration Techniques, Cache Coherency and Bus Snooping, Massively Parallel Processors (MPP).

Multithreaded Architecture: Multithreaded Processors, Latency Hiding Techniques, Principles of Multithreading, Issues and Solutions, Parallel Programming Techniques-Message Passing Program Development.

UNIT 5: (~10 Lecture Hours)

Parallel Algorithms for Multiprocessors: Classification and Performance of Parallel Algorithms, Operating Systems for Multiprocessors Systems, Message Passing Libraries for Parallel Programming Interface, Parallel Virtual Machine (PVM) (in distributed memory system), and Message Passing Interfaces (MPI).

Text Books:

1. Kai Hwang and Faye A. Briggs, "Computer Architecture and Parallel Processing", McGraw Hill Education, 1st Edition2012.
2. Kai Hwang, "Advanced Computer Architecture", McGraw Hill Education, 1993.

Reference Books:

1. John L. Hennessy and David A. Patterson, ".Computer Architecture: A Quantitative Approach", Elsevier, 5th Edition, 2012.
2. William Stallings, "Computer Organization and Architecture,Designing for Performance", PrenticeHall, 6th edition, 2006.
3. Kai Hwang, "Scalable Parallel Computing", McGraw Hill Education, 1998.
4. Harold S. Stone "High-Performance Computer Architecture",AddisonWesley, 1993.

Online Resources:

1. http://nptel.ac.in/courses/106102062/ (Course Title: Introduction to Computer Architecture by *Prof. Anshul Kumar, IIT Delhi*)
2. https://archive.nptel.ac.in/courses/106/105/106105033/(Course Title: High Performance Computer Architecture by Prof. Ajith pal, IIT Kharaghpur)
3. https://www.tutorialspoint.com/parallel_computer_architecture/ parallel_computer_architecture_models.htm (Title:Tutorials on Parallel Computer Architecture–Models

Course Outcomes(COs)

After completion of the course the students should be able to

CO1 Study the basics of parallelism, pipelining concepts, and pipeline architecture challenges.
CO2 Discuss the issues in vector and array processors.
CO3 Analyze the high performance scalable multi threaded and multiprocessor systems.
CO4 Explain different parallel algorithms for multiprocessors systems based on performance.
CO5 Recognize various memory contention and different arbitration techniques used in multiprocessors systems.
CO6 Illustrate various synchronization techniques for parallel programming interface.

❄ ❄ ❄

M.Tech. I Year, I Sem. **L T P C**
Course Code: 521BE **3 0 0 3**

REAL TIME OPERATING SYSTEMS
(Program Specific Elective-1)

Prerequisites: 1. Operating Systems

Course Objectives:

1. Understand the Real time scheduling theory concept.
2. Experience on real time scheduler implementation applied to real time systems.
3. Skills necessary to develop software for embedded computer systems using a real-time operating system.
4. Basic knowledge of RT Linux, MicroC/OS-II, Vx Works, Embedded Linux, and Tiny OS.

UNIT 1: (~ 10 Lecture Hours)
Introduction: Introduction to UNIX/LINUX, Overview of Commands, File I/O,(open, create, close, lseek, read, write), Process Control (fork, vfork, exit, wait, waitpid, exec).

UNIT 2: (~ 10 Lecture Hours)
Real Time Operating Systems: Brief History of OS, Defining RTOS, The Scheduler, Objects, Services, Characteristics of RTOS, Defining a Task, asks States and Scheduling, Task Operations, Structure, Synchronization, Communication and Concurrency. Defining Semaphores, Operations and Use, Defining Message Queue, States, Content, Storage, Operations and Use

UNIT 3: (~ 8 Lecture Hours)
Objects, Services and I/O: Pipes, Event Registers, Signals, Other Building Blocks, Component Configuration, Basic I/O Concepts, I/O Subsystem

UNIT 4: (~ 8 Lecture Hours)
Exceptions, Interrupts and Timers: Exceptions, Interrupts, Applications, Processing of Exceptions and Spurious Interrupts, Real Time Clocks, Programmable Timers, Timer Interrupt Service Routines (ISR), Soft Timers, Operations.

UNIT 5: (~ 9 Lecture Hours)
Case Studies of RTOS: RT Linux, MicroC/OS-II, Vx Works, Embedded Linux, and Tiny OS.

Text Books :

1. Qing Li, "Real Time Concepts for Embedded Systems", Elsevier, 2011
2. Embedded Real Time Systems: Concepts, Design Programming, Black book, Dreamtech Press 1st Edition 2003.

Reference Books:

1. W. Richard Stevens, Stephan A. Rago, "Advanced UNIX Programming", Pearson, 2nd Edition, 2006.
2. Dr. Craig Hollabaugh, "Embedded Linux: Hardware, Software and Interfacing", Pearson, 1st Edition, 2008.
3. Introduction to Embedded Systems - Shibu K.V, McGraw Hill, 2nd Edition 2016

Online Resources:

1. https://www.slideshare.net/pantechsolutions/rtos-basic-concepts (PPT slide on RTOS by PANTECH India Pvt. Ltd.)
2. https://onlinecourses.nptel.ac.in/noc20_cs16/preview (Course Title: Real Time Operating Systems by Prof. Rajib Mall, IIT Kharaghpur)

Course Outcomes(COs):

After completion of the course the student should be able to

CO1 Explain the concepts of UNIX operating systems.
CO2 Contrast Concepts of real time operating systems with GPOS.
CO3 Define Objects services and IO subsystems.
CO4 Instantiating with Exceptions, Interrupts and Timer operations built in RTOS.
CO5 Compare various Real Time OS.
CO6 Illustrate case study of RT Linux, uC/OS-II, Vx Works, Embedded Linux.

❄ ❄ ❄

M.Tech. I Year, I Sem **L T P C**
Course Code: 521BF **3 0 0 3**

ADVANCED DIGITAL SIGNAL PROCESSING (PSE-2)
(Common to DECE, WMC)

Prerequisites: Digital Signal Processing

Course Objectives:

1. To understand the importance of multirate digital signal processing and applications.
2. To have in-depth knowledge of linear prediction and power spectral estimation methods
3. To develop an understanding of subspace methods of power spectral estimation.
4. To compare the performance methods of parametric, non-parametric and subspace methods of power spectral estimation techniques.

UNIT 1: (~10 Lecture Hours)

Multirate Digital Signal Processing: Introduction, Decimation by a Factor D, Interpolation by a Factor I, Sampling Rate Conversion by a Rational Factor I/D, Filter Design and Implementation for Sampling Rate Conversion- Direct Form FIR Filter Structures, Polyphase Filter Structures. Multistage Implementation of Sampling Rate Conversion.

Applications of Multi Rate Signal Processing: Design of Phase Shifters, Interfacing of Digital Systems with Different Sampling Rates, Implementation of Digital Filter Banks, Sub-band Coding of Speech Signals, Quadrature Mirror Filters, Trans-multiplexers, Over Sampling A/D and D/A Conversion.

UNIT 2: (~8 Lecture Hours)

Linear Prediction and Optimum Linear filters: Representation of Stationary Random Process- Rational Power Spectra, Relationships between the filter parameters and Autocorrelation Sequence. Forward and Backward linear Prediction, Solution of Normal Equations-Shur Algorithm, AR Lattice and ARMA Lattice Ladder Filters, Wiener Filters for Filtering and Prediction.

UNIT 3: (~9 Lecture Hours)

Non-Parametric Methods of Power Spectral Estimation: Estimation of Spectra from Finite Duration Observation of Signals, Non-Parametric Methods: Bartlett, Welch & Blackman-Tukey Methods, Performance Characteristics of Non-Parametric Power Spectrum Estimators. Computational Requirements of Non-Parametric Power Spectrum Estimates.

UNIT 4: (~8 Lecture Hours)

Parametric Methods of Power Spectrum Estimation: Relation between Auto Correlation & Model Parameters, AR Models - Yule-Walker & Burg Methods, MA Model for Power Spectrum Estimation, ARMA Model for Power Spectrum Estimation.

UNIT 5: (~10 Lecture Hours)

Minimum Variance and Eigen Analysis based Spectral Estimation: Minimum Variance Spectrum Estimation, Eigen Analysis Algorithm for Spectral Estimation-Pisarenko Harmonic Decomposition Method, Eigen Decomposition of Autocorrelation Matrix for Sinusoids in White Noise, MUSIC Algorithm, ESPRIT Algorithm, Order Selection Criteria, and Comparison of Experimental Results for Spectral Estimation.

Text Books:

1. John G. Proakis and Dimitris C. Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", 4th Edition, Prentice Hall of India, Pvt. Limited, 2007
2. Alan V. Oppenheim and Ronald W. Schaffer, "Discrete Time Signal Processing", 2nd Ed, PHI, 2007.

Reference Books:

1. Emmanuel C. Ifeachor and Barrie W. Jervis. Addison "Digital Signal Processing: A Practical Approach", 2nd Edition, Pearson, 2002.
2. S. M .Kay, "Modern spectral Estimation techniques", 1st Edition, PHI, 1997.
3. P.P. Vaidyanathan "Multi Rate Systems and Filter Banks", Pearson Education, 1993.

Online Resources:

1. https://nptel.ac.in/courses/117101001
   (Course Title: Advanced Digital Signal Processing-Multirate and wavelets. Prof. V. M. Gadre, IIT, Bombay.)
2. https://www.youtube.com/playlist?list=PLD85E88483F782338
   (Course Title: Probability and Random Variables by Prof. M. Chakraborty, Department of Electronics and Electrical Communication Engineering, IIT, Kharagpur.)

Course Outcomes (COs)

After completion of the course the student should be able to

CO1 Define the basic features of multirate digital signal Processing, Spectral estimation techniques and describe the sampling rate conversion principles.

CO2 Describe the relationship between the filter parameters and autocorrelation sequences for linear prediction and optimum filtering.

CO3 Identify the non-parametric methods of power spectral estimation, their computational requirements and calculate the performance characteristics.

CO4 Aanalyze the parametric methods of power spectral estimation using AR, MA, ARMA Models.

CO5 Assess and compare the power spectral estimates using minimum variance and eigen analysis based methods

CO6 Discuss and compare the subspace methods of spectral estimation employing MUSIC and ESPRIT algorithms.

❄ ❄ ❄

M.Tech. I Year, I Sem **L T P C**
Course Code: 521BG **3 0 0 3**

MOBILE COMPUTING (PSE 2)

(Common to DECE, WMC)

Prerequisite: Computer Networks, Computer Organization and architecture.

Course Objectives:

The objectives of the course Mobile Computing are

1. To learn the fundamental technologies that help in the networking of wireless devices.
2. To study the cellular architectures of GSM, GPRS, SMS.
3. To have an exposure about emerging technologies like Blue tooth, WiMAX etc.
4. To know the Network, Transport functionalities of Mobile Communication.
5. To impart knowledge about Mobile Application Development using Palm OS, Symbian OS, J2ME etc.

UNIT – 1: (~9 Lecture Hours)

Introduction to Mobile Computing Architecture: Mobile Computing, dialog control, networks, middleware and gateways, application and services, developing mobile computing applications, security in mobile computing, architecture for mobile computing, three tier architecture, design considerations for mobile computing, mobile computing through internet, making existing applications mobile-enabled.

UNIT – 2: (~9 Lecture Hours)

Cellular Technologies – GSM, GPRS, CDMA AND 3G : Wireless Broadband, mobile IP, Internet protocol version 6 (IPv6), Java card, PLNM interfaces, GSM addresses and identifiers, network aspects in GSM, Mobile computing over SMS, Short Message Services (SMS), GPRS network architecture, GPRS network operations, data services in GPRS, applications for GPRS, limitations of GPRS, CDMA versus GSM, third generation networks, applications on 3G, Introduction to 4G & 5G Communications.

UNIT – 3: (~8 Lecture Hours)

Wireless Application Protocol (WAP) and Wireless LAN: WAP, MMS, wireless LAN advantages, IEEE 802.11 standards, wireless LAN architecture, mobility in wireless LAN.

Intelligent and Internetworking: Introduction, fundamentals of call processing, intelligence in the networks, SS#7 signaling, IN Conceptual Model (INCM), Softswitch, programmable networks, technologies and interfaces for IN.

UNIT – 4: (~10 Lecture Hours)

Client Programming, PALM OS, SYMBIAN OS, WIN CE Architecture: Introduction, moving beyond the desktop, a peek under the hood: hardware overview, mobile phones, PDA, design constraints in applications for handheld devices, palm OS architecture, application development, Symbian OS architecture, Applications for Symbian, different flavors of windows CE, windows CE architecture.

J2ME: Java in the handset, the three prong approach to JAVA everywhere, JAVA 2 micro edition (J2ME) technology, programming for CLDC, MIDLet, Optional packages.

UNIT – 5: (~9 Lecture Hours)

Voice Over Internet Protocol and Convergence:

Voice over IP, H.323 Framework for voice over IP, Session Initiation Protocol, Comparison between H.323 and SIP, Real Time protocols, Convergence Technologies, Call Routing, IP multimedia subsystem (IMS), Mobile VoIP.

Security Issues in Mobile Computing: Introduction, information security, security techniques and algorithms, security protocols, trust, security models, security frameworks for mobile environment.

Text Books:

1. Mobile Computing – Technology, Applications and Service Creation, Asoke K. Talukder, Roopa R Yavagal, 2nd edition, Tata McGraw Hill, New Delhi, 2009.
2. Mobile Communications, Jochen Schiller, 2nd Edition, Pearson Education, New Delhi, 2008.

Reference Books:

1. The cdma2000 system for Mobile Communications, VieriVanghi, Aleksander Damnjanovic, Pearson Education, New Delhi, 2007.
2. Fundamentals of Mobile and Pervasive Computing, Frank Adelstein, McGraw Hill, New Delhi, 2008.

Online Resources:

1.https://www.tutorialspoint.com/mobile_computing/mobile_computing_overview.htm
2. http://uberthings.com/mobile/#intro
3. http://www.ittoday.info/Articles/Introduction_to_Mobile.htm
4. https://www.cse.wustl.edu/~jain/cse574-16/ftp/j_195g.pdf

Course Outcomes (COs)

After completion of the course students should be able to:

CO1 Articulate the basics of Mobile Computing and Communication standards.
CO2 Describe Mobile Communication and Computing Architectures.
CO3 Demonstrate the knowledge of various platforms like Palm OS, Symbian OS and Windows CE used for mobile devices.
CO4 Develop mobile applications using JAVA 2 micro edition (J2ME) technology.
CO5 Differentiate H.323, SIP and other protocols, frameworks for VoIP.
CO6 Analyze various security protocols and able to deal with security attacks in mobile environment.

M.Tech. I Year, I Sem **L T P C**
Course Code: 521BH **3 0 0 3**

CODING THEORY AND TECHNIQUES (PSE-2)
(Common to DECE, WMC)

Prerequisites: Digital Communications

Course Objectives:

1. To expose the students to the principles of Error-correcting codes, and their applications to communication systems with noise.
2. To understand the methods for speedy/compact Error Detection and Correction.
3. To compare different Error Detection and Correction schemes.
4. To analyze the latest Channel Coding Techniques.

UNIT 1: (~9 Lecture Hours)

Coding for Reliable Digital Transmission and storage: Types of Errors, Error Control Strategies.

Linear Block Codes: Introduction to Linear Block Codes, Syndrome and Error Detection, Minimum Distance of a Block code, Error-Detecting and Error-correcting Capabilities of a Block code, Standard array and Syndrome Decoding, Probability of an undetected error for Linear Codes over a BSC, Hamming Codes. Applications of Block codes for Error control in data storage system.

UNIT 2: (~10 Lecture Hours)

Cyclic Codes: Description, Generator, and Parity-check Matrices, Encoding, Syndrome Computation, and Error Detection, Decoding, Cyclic Hamming Codes, shortened cyclic codes, Error-trapping decoding for cyclic codes, Majority logic decoding for cyclic codes. Introduction to BCH codes.

UNIT 3: (~8 Lecture Hours)

Convolutional Codes: Encoding of Convolutional Codes, Structural and Distance Properties, maximum likelihood decoding, Sequential decoding, Majority- logic decoding of Convolution codes. Application of Viterbi Decoding and Sequential Decoding, Applications of Convolutional codes in ARQ system.

UNIT 4: (~10 Lecture Hours)

Turbo & LDPC Codes:

Turbo Codes: Concatenated convolutional codes- Parallel concatenation,

The UMTS Turbo code, Serial concatenation, Partial concatenation, Turbo decoding.

LDPC Codes: Codes based on sparse graphs, Decoding for binary erasure channel, Log-likelihood algebra, Belief propagation, Product codes, Iterative decoding of product codes.

UNIT 5: (~8 Lecture Hours)

Space-Time Codes: Introduction, Digital modulation schemes, Diversity, Orthogonal space- Time Block codes:Alamouti's schemes, Extension to more than Two Transmit Antennas, Simulation Results, Spatial Multiplexing: General Concept, Iterative APP Preprocessing, and Per-layer Decoding, Linear Multilayer Detection, Original BLAST Detection, QL Decomposition, and Interface Cancellation, Performance of Multi-Layer Detection Schemes, Unified Description by Linear Dispersion Codes.

Text Books:

1. Shu Lin, Daniel J.Costello, Jr, "Error Control Coding- Fundamentals and Applications", 2nd Editions, Prentice Hall, 2017.
2. Andre Neubauer, Jurgen Freadenberger, Volker Kuhn, "Coding Theory- Algorithms, Architectures and Applications", 1st Edition, John Wiley & Sons Ltd, 2007.

Reference Books:

1. Bernard Sklar, "Digital Communications-Fundamentals and Applications", 2nd Edition, PEA, 2013.
2. Man Young Rhee, "Error Correcting Coding Theory", McGraw-Hill Publishing, 1989.
3. John G. Proakis, "Digital Communications", 5th Edition, Tata McGraw-Hill, 2008.
4. Todd K.Moon, "Error Correction Coding-Mathematical Methods and Algorithms", Wiley India, 2006.
5. Ranjan Bose, "Information Theory, Coding and Cryptography", 2nd Edition, Tata McGraw-Hill, 2009.

Online Resources:

1. http://nptel.ac.in/courses/117106031
   (Corse Title: Coding Theory, Dr. Andrew Thangaraj, IIT Madras)
2. https://nptel.ac.in/courses/117108044
   (Corse Title: Error Correcting Codes, Prof. P. Vijay Kumar, IISc Bangalore)

Course Outcomes (COs)

After completion of the course the student should be able to

CO1 Narrate the need & basics for error detecting & correcting codes in data communications & storage systems.

CO2 Explain the operating principle of block codes, cyclic codes, convolution codes, turbo codes, LDPC codes & space-time codes.

CO3 Apply mathematical tools like finite fields for designing multiple error correcting codes.

CO4 Analyze the error detection & correction capabilities of various codes.

CO5 Compare the performances of error correcting codes in terms of channel parameters & probability of error.

CO6 Choose the appropriate error correcting scheme according to the BER and signal-to-noise ratio & specify the requirement.

❄ ❄ ❄

M.Tech. I Year, I Sem **L T P C**
Course Code: PC52115 **0 0 3 1.5**

DIGITAL SYSTEM DESIGN LAB (PCL-1)

Prerequisites: 1. Digital System Design.

Course Objectives:

1. To Verify the Functionality of Various Combinational Circuits using Verilog/VHDL Programming Language.
2. To Verify the Functionality of Sequential Circuits using Verilog/VHDL Programming Language.
3. To Implement the Combinational and Sequential Circuits using FPGAs Kit.
4. To Perform the Circuit Simulation and Layout Verification for Combinational and Sequential Circuits.

PART:1

List of Experiments:

Programming can be Done using Xilinx/Vivado ISE Simulation Tool and Implement the Programs on FPGA Board.

1. Design and Implement Full Adder, 4-bit Ripple Carry Adder and Carry Look Ahead adder.
2. Design and Implement 4-bit ALU to Perform – ADD, SUB, AND, OR, XOR, 1's and 2's Complement Operations.
3. Design and Implement 4x1, 8x1 and 16x1 Multiplexer in Dataflow and Structural Model.
4. Design and Implement 1x4, 1x8 and 1x16 Demultiplexer in Dataflow and Structural Model.
5. Design and Implement 2 to 4, 3 to 8 and 4 to16 line decoder in Dataflow and Structural Model.
6. Design and Implement 16-to-4 (With and Without Priority) Encoder in Behavioral Model.
7. Design and Implement Code converters – Binary to BCD code, BCD to Gray code and BCD to Excess -3 code.
8. Design and Implement SR, D, JK, and T flip flops using Behavioral Model.
9. Design and Implement 4-bit Binary and BCD Counters (with Synchronous/ Asynchronous Reset input) using Behavioral Model.

PART-II

PART -II Experiments can be done by Mentor Graphics/Cadence/Synapsys Tools.

1. Simulate and Verify the Layouts of all CMOS Logic Gates.
2. Simulate and Verify the Layouts of 28 Transistor and 10 Transistor Full Adder.
3. Simulate and Verify the Layout of Full Adder using Dynamic CMOS Technology.
4. Simulate and Verify the Layouts of SR, D, JK And T Flip Flops.
5. Simulate and Verify the Layout of 4-bit Binary Asynchronous/Synchronous Counter.

Text Books:

1. Samir Palnitkar, "Verilog HDL, A Guide to Digital Design and Synthesis" Prentice Hall, Second Edition, 2003.
2. Stephen Brown & Zvonko G. Vranesic, "Digital Logic Design with Verilog HDL" TATA McGraw Hill Ltd. 2nd Edition 2007.

Reference Books:

1. T.R. Padmanabhan, B. Bala Tripura Sundari, "Design through Verilog HDL, A John Wiley & Sons, INC., Publications 2008.
2. Peter Ashenden, "Digital Design using Verilog", Elsevier, 2007.

Online Resources:

1. https://nptel.ac.in/courses/106105165,(Course Title: Hardware Modeling using Verilog Prof. Indranil Sengupta, IIT Kharagpur)
2. https://onlinecourses.nptel.ac.in/noc22_ee104/course(Course Title: System Design Through Verilog, Prof.Shaik Rafi Ahamed)

Course Outcomes (COs)

After completion of the course the student should be able to

CO1 Recall the Verilog HDL Concepts for Digital Circuits.

CO2 Construct, Simulate and Synthesize the Digital Circuits using Xilinx Vivado ISE Tool.

CO3 Implement the Combinational and Sequential Circuits using FPGAs Kit.

CO4 Perform Circuits Simulation, DC/Transient Analysis and Static Timing Analysis of Digital CMOS Circuits using Mentor Graphics/Cadence/Synapsys Tools.

CO5 Physical Verification and Layout Verification of Digital CMOS Circuits using Mentor Graphics/Cadence/ Synapsys Tools.

❄ ❄ ❄

M.Tech. I Year, I Sem **L T P C**
Course Code:PC52116 **0 0 3 1.5**

ADVANCED WIRELESS COMMUNICATIONS LABORATORY

Prerequisites : Nil

Course Objectives:

1. Learn about Cellular concepts.
2. Understand and develop concepts of Software Define Radio
3. Analyze GSM handset by experimentation and fault insertion techniques
4. Understand of 3G communication system by means of various AT commands usage in GSM
4. Understanding CDMA concept using DSSS kit
5. Model 4G communication system.

Experiments: Experiments 1-3, 5-8, 14 need to be simulated using MATLAB. Experiments 4, 9-13 need to be tested in respective hardware.

1. Calculate the boundary coverage probability in a cellular system using fading channel mobile communication.
2. Understanding Cellular Fundamentals Frequency Reuse, Handoff, interference in mobile communication system using Matlab.
3. Simulation of fading channels in wireless communication system using Matlab.
4. Study of various building blocks of Software Define Radio in real time environment.
5. Simulation of space diversity combing methods using Matlab.
6. Simulation of multiple access schemes using Matlab.
7. Simulation of the following Outdoor Path loss propagation models using Matlab. a. Free Space Propagation model b. Okumura model c. Hata model
8. Simulation of Adaptive Linear Equalizer using MAT LAB software.
9. Study of GSM handset for various signaling and fault insertion techniques (Major GSM Handset sections: clock, SIM card, charging, LCD module, Keyboard, User interface).
10. Study transmitter and receiver section in mobile handset and measure frequency band signal and GMSK modulating signal.
11. Simulation of RAKE Receiver for CDMA communication using MAT LAB software.
12. Simulate and test the 3G Network system features using GSM AT Commands.
13. Simulate and test various types of PN codes, chip rate, spreading factor and processing gain on performance of DSSS in CDMA.
14. Modelling of OFDM system using Simulink.

Course Outcomes (COs)

After completion of the course the student should be able to

CO1 Comprehend Cellular concepts of GSM and CDMA networks.
CO2 Calculate path loss for Free space, Okumura and Hata models for outdoor propagation.
CO3 Simulate RAKE receiver for CDMA with MATLAB.
CO4 Analyze GSM architecture.
CO5 Analyze and design OFDM system.
CO6 Understand transceiver blocks of Software Define Radio.

M.Tech. I Year, I Sem **L T P C**
Course Code:PW521BJ **2 0 0 2**

RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS (PW)
(Common to PEED, DECE,CSE, CNIS, WMC)

Prerequisites: : None

Course Objectives:

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

UNIT 1: (~7 Lecture Hours)

Research Methodology: Objectives and Motivation of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Methods, Importance of Research Methodology, Research Process, Criteria of Good Research.

UNIT 2: (~6 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, Developing a Research Plan, Design of Experimental Set-up, Use of Standards and Codes, 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: (~5 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. Introduction to the use of software tools : Grammarly, Overleaf and References function in Microsoft word.

UNIT 4: (~5 Lecture Hours)

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

UNIT 5: (~8 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, 2012.
2. Halbert, "Resisting Intellectual Property", Taylor& Francis Ltd, 2007.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc20_hs55
   (Course Title : Patent Law for Engineers and Scientists, by Dr. Feroz Ali (IIT Madras))
2. https://onlinecourses.nptel.ac.in/noc20_hs54
   (Course Title : Patent Drafting for Beginners, by Dr. Feroz Ali (IIT Madras))

Course Outcomes(COs):

After completion of the course the student should be able to

CO1 Describe research problem formulation and outline the Research Design process.

CO2 Identify the various methods of Data Collection.

CO3 Demonstrate the ability to draft Research Report, Synopsis and Dissertation with appropriate Bibliography/ Webliography while conforming to research ethics.

CO4 Categorize various forms of Intellectual Property and list out the steps involved in Patenting.

CO5 Justify the need for Patenting and Transfer of Technology in the socio-economic growth of the society.

CO6 Develop a Research Proposal and Research Grant Proposal.

❄ ❄ ❄

M.Tech. I Year, II Sem. **L T P C**
Course Code: PC522BK **3 0 0 3**

ARM MICROCONTROLLERS AND PROGRAMMABLE DIGITAL SIGNAL PROCESSORS
(Professional Core-3)

Prerequisites: 1. Microprocessors and Microcontrollers 2. Digital Signal Processing

Course Objectives:

1. To understand the internal architecture of ARM Cortex M3.
2. To provide basics of Exceptions and Interrupts.
3. To impart knowledge of Programmable DSP (P-DSP) Processors.
4. To familiarize the internal architecture of TMS320C6000 series.

UNIT 1: (~ 12 Lecture Hours)

ARM Cortex-M3 processor: Applications, Programming model – Registers, Operation modes, Exceptions and Interrupts, Reset Sequence Instruction Set, Unified Assembler Language, Memory Maps, Memory Access Attributes, Permissions, Bit-Band Operations, Unaligned and Exclusive Transfers. Pipeline, Bus Interfaces.

UNIT 2: (~ 7 Lecture Hours)

Exceptions: Exceptions, Types, Priority, Vector Tables, Interrupt Inputs and Pending behavior, Fault Exceptions, Supervisor and Pendable Service Call.

UNIT 3: (~ 8 Lecture Hours)

Interrupts: Nested Vectored Interrupt Controller, Basic Configuration, SYSTICK Timer, Interrupt Sequences, Exits, Tail Chaining, Interrupt Latency.

UNIT 4: (~ 8 Lecture Hours)

Programmable DSP (P-DSP) Processors: Harvard Architecture, Multi-port memory, Architectural structure of P-DSP- MAC unit, Barrel shifters, Introduction to TI DSP processor family.

UNIT 5: (~ 10 Lecture Hours)

VLIW architecture and TMS320C6000 series: Architecture study, Data paths, Cross paths, Introduction to Instruction level architecture of C6000 family, Assembly Instructions memory addressing, for arithmetic, logical operations. Code Composer Studio for application development for Digital signal processing, On chip peripherals, Processor benchmarking.

Text Books:

1. Joseph Yiu, "The definitive guide to ARM Cortex-M3", Elsevier, 2nd Edition, 2011.
2. Venkatramani B. and Bhaskar M. "Digital Signal Processors: Architecture, Programming and Applications", TMH, 2nd Edition, 2002.
3. Sloss Andrew N, Symes Dominic, Wright Chris, "ARM System Developer's Guide: Designing and Optimizing", Morgan Kaufman Publication 2nd Edition, 2004.

Reference Books:

1. Steve Furber, "ARM System-on-Chip Architecture", Pearson Education 2nd Edition , 2001.
2. Frank Vahid, Tony Givargis, "Embedded System Design A Unified Hardware Software Introduction", John Wiley India, Edition-Studentedition, 2014.

Online Resources:

1. https://nptel.ac.in/courses/117106111(ARM based development byProf. S. Chandramouleeswaram, IIT Madras)
2. Technical reference manuals from www.arm.com ,www.ti.com

Course Outcomes(COs):

After completion of the course the students should be able to

CO1 Narrate the basic features of the Cortex-M3 processor, applications, list its instruction set, and outline the memory attributes.

CO2 Classify and illustrate exceptions and interrupts for interfacing peripherals with Cortex-M3 and characterize the NVIC.

CO3 Identify the architectural features of P-DSP processors, and apply the MAC unit and barrel shifter for real-time computations.

CO4 Distinguish between the TI DSP processor family, Cortex-M3 versions, and compare their instruction sets, memory configurations, and related software development tools.

CO5 Interpret the VLIW architectural features, addressing modes, instruction sets, and on-chip peripherals of TMC320C6000 series processors and develop application programs using the code composer studio tool.

❄ ❄ ❄

M.Tech. I Year, II Sem **L T P C**
Course Code:PC522BL **3 0 0 3**

ADVANCED COMMUNICATION NETWORKS

Prerequisite: Computer Networks

Course Objectives:

By studying this course, student will be able to understand

1. Communication networking concepts.
2. Real time protocols in communication networking.
3. Quality of Service and network design.

UNIT 1: (~8 Lecture Hours)

TCP/IP Protocol suite, IPv4, IPv6, ICMPv4, ICMPV6 Protocol, Concepts of Routing Protocols, Transition from IPV4 to IPV6.

Transport Layer protocols: TCP Services, TCP Features, Segments, TCP Connection, State Transition Diagram, Windows in TCP, Flow and Error Control, TCP Congestion Control, TCP Timers, UDP- User Datagram, UDP Services, UDP Applications

UNIT 2: (~8 Lecture Hours)

Congestion Control and Quality of Service: Data Traffic, Congestion, Congestion Control, Quality of Service, Techniques to Improve QoS.

ATM: Design Goals, ATM Architecture, Switching, Switch Fabric, ATM Layers, Service Classes, ATM Application.

SONET/SDH: Architecture, SONET Layers, SONET Frames, STS Multiplexing, SONET Networks.

UNIT 3: (~10 Lecture Hours)

Integrated Services

Real-time applications, Integrated Services Architecture, Service Models. Resource Reservation Setup (RSVP), Flow Identification, Packet Scheduling.

Differentiated services

Differentiated Services Framework, Differentiated Services Field, Traffic Classification and Conditioning, Assured Forwarding, Expedited Forwarding, Packet Classification, End-To-End Resource Management, Performance Issues In Differentiated Services

UNIT 4: (~12 Lecture Hours)

Multiprotocol Label Switching

Introduction, IP over ATM Integration, Simpler Forwarding Paradigm, Traffic Engineering, Routing vs. Switching, Label-Switching Proposals, Comparison of Approaches, MPLS architecture, Label Distribution Protocols

Multimedia

Multimedia Data, Multimedia in The Internet, Real-Time Interactive Protocols: RTP,RTCP,SIP, H.323

UNIT 5: (~10 Lecture Hours)

Quality of Service in Ad Hoc Wireless Networks: Introduction, Real Time Traffic Support in Ad Hoc Wireless Networks, QoS Parameters in Ad Hoc Wireless Network, Issues and Challenges in providing QoS in Ad Hoc Wireless Networks, Classification of QoS Solutions: MAC Layer Solutions, Cluster TDMA, IEEE 802.11e, DBASE, Network Layer Solutions, QoS Routing Protocols, Ticket Based QoS Routing Protocol, Predictive Location Based QoS routing protocol, Trigger Based Distributed QoS Routing Protocol, QoS enabled AODV Routing Protocol, Bandwidth QoS Routing Protocol, On Demand QoS Routing Protocol, On Demand Link-State Multipath QoS Routing Protocol, Asynchronous Slot Allocation Strategies. QoS Frameworks for Ad Hoc Wireless Networks.

Text Books:

1. B. A.Forouzan, "Data Communications and Networking", 5th Edition, TMH, 2013.
2. Zhang Wang, "Internet QoS", 1st Edition, Morgan Kaufman Publishers, 2001.
3. B. S. Manoj and C. Shiva Ram Murthy, "Ad Hoc Wireless Networks Architecture and Protocols", 1st Edition, PHI, 2004.

Reference Books:

1. S. Keshav, "An Engineering Approach to Computer Networking: ATM Networks, the Internet and the Telephone Networks", 3rd Edition, Pearson Publications, 2005.
2. Larry L. Peterson & Bruce S. Davie, "Computer Networks: A System Approach", 3rd Edition, Morgan Kaufmann Publishers, 2003.
3. George Kesidis, "ATM Network Performance", 2nd Edition, Kluwer Academic Research Papers, 2005.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc18_cs38/preview: Sowmya K. Ghosh & Sandip Chakraborthy
2. www.coursera.org

CourseOutcomes(COs)

After completion of the course the student should be able to

CO1 Relate the concepts of TCP/IP and Network Parameters.

CO2 Interpret the concepts of TCP, UDP, SCTP, Integrated Services Model, Resource reservation in Internet

CO3 Model to the architectures of Integrated Services, Differentiated services, ATM and SONET.

CO4 Analyze the routing protocols in Internet and Ad Hoc Networks

CO5 Measure the Quality of Service in Internet & Ad Hoc Wireless Networks.

❄ ❄ ❄

M.Tech. I Year, I Sem **L T P C**
Course Code:522BM **3 0 0 3**

COMPUTER VISION (PSE-3)

Prerequisites: -Nil-

Course Objectives:

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

UNIT 1: (~ 9 Lecture Hours)

IMAGE PROCESSING: Fundamental steps in Digital image processing, Components of an Image Processing System, Image sensing and acquisition, Image sampling and quantization, Basic Relationships between pixels.

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

UNIT 2: (~ 8 Lecture Hours)

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

UNIT 3: (~ 10 Lecture Hours)

Feature Extraction: Histogram Processing, Color: Color Fundamentals, Color Models.

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

UNIT 4: (~ 9 Lecture Hours)

Mathematical Morphology: Erosion and Dilation, Opening and Closing.

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

UNIT 5: (~ 9 Lecture Hours)

Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Supervised, Unsupervised, Semi supervised, Classifiers: Bayesian Statistics, KNN, Dimensionality Reduction: PCA, ICA.

Text Books:

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

Reference Books:

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

Online Resources:

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

Course Outcomes:

After completion of the course, students will be able to

1. Define all concepts of image processing and Computer Vision.
2. Discuss the various operations on images and Computer Vision.
3. Identify the operations of Computer Vision like edge detection, Feature extraction, Linear Filtering.
4. Distinguish between the various operations of image analysis.
5. Decide the sequence of operations that can be applied in the process of segmentation.
6. Formulate computer vision applications and perform the operations of pattern analysis.

❄ ❄ ❄

M.Tech. I Year, II Sem. **L T P C**
Course Code:522BN **3 0 0 3**

LOW POWER CMOS VLSI DESIGN
(Professional Elective-3)

Prerequisites: CMOS VLSI Design

Course Objectives:

1. To Develop CMOS Digital Circuits for a Low Voltage Low Power Environment.
2. To Acquire the Knowledge on the Concepts of Device Behavior and Modelling.
3. To Understand the Concepts of Low Voltage, Low Power Circuits.
4. To Design Low Power Memory and Microprocessor Systems.

UNIT 1: (~ 9 Lecture Hours)

Technology & Circuit Design Levels: Sources of power dissipation in digital ICs, degree of freedom, recurring themes in low-power, emerging low power approaches, dynamic dissipation in CMOS, effects of Vdd and Threshold voltage on speed, constraints on Threshold voltage reduction, transistor sizing & optimal gate oxide thickness, impact of technology scaling, technology innovations.

UNIT 2: (~ 9 Lecture Hours)

Low Power Circuit Techniques: Power consumption in circuits, flip-flops &latches, high capacitance nodes, energy recovery, reversible pipelines, high performance approaches.

UNIT 3: (~ 9 Lecture Hours)

Low Power Clock Distribution: Power dissipation in clock distribution, single driver versus distributed buffers, buffers & device sizing under process variations, zero skew Vs tolerable skew, chip & package co-design of clock network.

UNIT 4: (~ 10 Lecture Hours)

Logic Synthesis for Low Power estimation techniques: Power minimization techniques, Low power arithmetic components- circuit design styles, adders, multipliers.

Low Power Memory Design: Sources & reduction of power dissipation in memory Subsystem, sources of power dissipation in DRAM & SRAM, low power DRAM circuits, low power SRAM circuits.

UNIT 5: (~ 8 Lecture Hours)

Low Power Microprocessor Design System: Power management support, architectural trade offs for power, choosing the supply voltage, low-power clocking, implementation problem for low power, comparison of microprocessors for power &performance.

Text Books :

1. Rabaey, Jan M., Pedram, Massoud, "Low Power Design Methodologies"Springer US Publisher, 1996.
2. Kaushik Roy, Sharat Prasad, "Low power CMOS VLSI circuit design", JohnWiley sons Inc., 2000.

Reference Books:

1. P. Rashinkar, Paterson and L. Singh, "Low Power Design Methodologies", Kluwer Academic, 2002
2. J.B.Kulo and J.H Lou, "Low voltage CMOS VLSI Circuits", Wiley, 1999.
3. A.P.Chandrasekaran and R.W.Broadersen, "Low power digital CMOS design", Kluwer, 1995.
4. Gary Yeap, "Practical low power digital VLSI design", Kluwer, 1998.

Online Resources

1. https://nptel.ac.in/courses/106105034(Course Title:Low Power VLSI Circuits and Systems by Prof.Ajit Paul, IIT Kharagpur)
2. https://freevideolectures.com/course/4717/nptel-vlsi-physical-design/58 (Course Title:VLSI Physical Design by Prof.Indranil Sengupta, IIT Kharagpur)

Course Outcomes(COs)

After completion of the course the student should be able to

CO1 Describe the concept of low power design and physics of power.
CO2 Realize the impact of power on system performance and reliability
CO3 Develop Knowledge about different Low power estimation Techniques.
CO4 Familiarize on various leakage sources and reduction techniques.
CO5 Estimate power dissipation in clock distribution
CO6 Design and develop low power Memory and Microprocessor systems.

❄ ❄ ❄

M.Tech. I Year, II Sem **L T P C**
Course Code: 522BP **3 0 0 3**

DESIGN OF FAULT TOLERANT SYSTEMS

Prerequisites: Digital System Design

Course Objectives:

1. To understand need for testing of manufactured ICs and the testing terminology.
2. To understand the concepts involved in making ICs Fault Tolerant and Self Checking
3. To build digital circuits which are easily testable.

UNIT 1: (~8 Lecture Hours)

Concepts of Reliability: Reliability, Failures & Faults, Reliability and Failure Rate, Relation between Reliability and Mean Time Between Failure, Maintainability and Availability, Reliability of Series, Parallel and Parallel-Series Combinational Circuits.

Fault Tolerant Design: Basic Concepts, Static, Dynamic, Hybrid, Triple Modular Redundant System (TMR), 5MR Reconfiguration Techniques, Fault Tolerant Design of Memory Systems, Time Redundancy and Software Redundancy.

UNIT 2: (~8 Lecture Hours)

Self Checking Circuits & Fail Safe Design: Self Checking Circuits: Basic Concepts of Self Checking Circuits, Design of Totally Self Checking Checker, Checkers for m out of n Codes, Berger Code and Low Cost Residue Code.

Fail Safe Design: Strongly Fault Secure Circuits, Fail Safe Design of Sequential Circuits using Partition Theory and Berger Code, Totally Self Checking PLA Design.

UNIT 3: (~12 Lecture Hours)

Design for Testability: Need for Testing, Fault Models – Stuck At Faults, Transistor Faults, Bridging Faults, Fault Simulation – Serial, Parallel, Concurrent and Deductive Fault Simulation, Test Generation Basics, Controllability and Observability, SCOAP, Fault – Oriented Test Generation.

Design for Testability by means of scan: Making circuits Testable, Testability Insertion, Full Scan DFT Techniques- Full Scan Insertion, Flip-Flop Structures, Full Scan Design and Test, Scan Architectures–Full Scan Design, Shadow Register DFT, Partial Scan Methods, Multiple Scan Design, Other Scan Designs, RT Level Scan Design – RTL Design Full Scan, RTL Design Multiple Scan, Scan Designs for RTL.

UNIT 4: (~10 Lecture Hours)

Logic Built-in-self-test: BIST Basics–Memory Based BIST,BIST Effectiveness, BIST Types, Designing a BIST, Test Pattern Generation - Engaging TPGs, Exhaustive Counters, Ring Counters, Twisted Ring Counter, Linear Feedback Shift Register, Output Response Analysis-Engaging ORA's, One's Counter, Transition Counter, Parity Checking, Serial LFSRs, Parallel Signature Analysis, BIST Architectures-BIST Related Terminologies, Centralized and Separate Board-Level BIST Architecture, Built-in Evaluation and Self Test(BEST), Random Test Socket(RTS), LSSD On-chip Self Test, Self Testing using MISR and SRSG, Concurrent BIST, BILBO, Enhancing Coverage, RT Level BIST Design -CUT Design, Simulation and Synthesis, RTS BIST Insertion,

Configuring the RTS BIST, Incorporating Configurations in BIST, Design of STUMPS, RTS and STUMPS Results.

UNIT 5: (~8 Lecture Hours)

Standard IEEE Test Access Methods: Boundary Scan Basics, Boundary Scan Architecture– Test Access port, Boundary Scan Registers, TAP Controller, Decoder Unit, Select and Other Units, Boundary Scan Test Instructions- Mandatory Instructions, Board Level Scan Chain Structure - One Serial Scan Chain, Multiple Scan Chain with One Control Test Port, Multiple Scan Chains with One TDI,TDO but Multiple TMS, Multiple-Scan Chain & Multiple Access Port, RT Level Boundary Scan- Inserting Boundary Scan Test Hardware for CUT, Two Module Test Case, Virtual Boundary Scan Tester, Boundary Scan Description Language.

Text Books:

1. Parag K. Lala, "Fault Tolerant & Fault Testable Hardware Design", PHI, 1985.
2. Zainalabedin Navabi, "Digital System Test and Testable Design using HDL models and Architectures", Springer International Edition, 2014.

Reference Books:

1. Miron Abramovici, Melvin A. Breuer and Arthur D. Friedman, "Digital Systems Testing and Testable Design", JaicoPublishing House, 2006.
2. Bushnell M & Vishwani D. Agarwal, "Essentials of Electronic Testing", Springer, 2004.
3. Laung-Terng Wang, Cheng-Wen Wu, Xiaoqing Wen, "VLSI Test Principles and Architectures: Design for Testability", Morgan Kaufmann, 2006.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc20_ee76/preview- Digital VLSI Testing by Prof. Santanu Chattopadhyay, Department of Electronics and Electrical Communication Engineering, IIT Kharagpur
2. https://www.youtube.com/watch?v=lRpt1fCHd8Y&list=PLzBynYJnzI5kA05fRGrVlen5WSu12amj3– VLSI Physical Design by Prof Indranil Sengupta, Department of Computer Science and Engineering, IIT Kharagpur

Course Outcomes(COs):

After completion of the course the student should be able to

CO1 Recognize the need for fault models, fault tolerance circuits, controllability, and observability in generation of test vectors for testing digital systems.

CO2 Explain the principles required to build testable integrated circuits.

CO3 Demonstrate different approaches to build Fault Tolerant, Self-Checking and Testable Circuits.

CO4 Analyze the ease with which testing can be performed after applying testing principles in the design of integrated circuits.

CO5 Estimate the impact of incorporating different DFT architectures into digital designs using RTL code.

CO6 Design different architectures for Chip Level and System Level DFT.

M.Tech. I Year, II Sem **L T P C**
Course Code: 522BQ **3 0 0 3**

COMMUNICATION AND NETWORKING TECHNOLOGIES FOR IoT
(Program Specific Elective-4)

Prerequisites: Nil

Course Objectives:

1. To study the basic concepts and theory of Internet of Things (IoT).
2. To familiarize the device-to-device/machine-to-machine integration concepts in IoT.
3. To understand the wireless technologies and protocols for IoT Ecosystem.
4. To discuss the Integration Technologies of IoT and Smart Use Cases of IoT.

UNIT 1: (~ 7 Lecture Hours)

Introduction to IoT: Flavor of the Internet of Things, Technology of the Internet of Things and Enchanted Objects, Design Principles for Connected Devices, Calm and Ambient Technology, Web Thinking for Connected Devices, First-Class Citizens On The Internet, Thinking About Prototyping, Sketching, Familiarity, Prototypes and Production, Open Source versus Closed Source, Closed Source for Mass Market Projects, Tapping into the Community.

UNIT 2: (~ 10 Lecture Hours)

IoT Paradigm: Why the IoT Is Strategically Sound, Brewing and Blossoming Trends in IT Space, Envisioning the Internet of Things Era, Device-to-Device/Machine-to-Machine Integration Concepts-Device-to-Cloud (D2C) Integration, Sensor-to-Cloud Integration, Emerging IoT Flavors, Prominent IoT Realization Technologies, Cloud-to-Cloud (C2C) Integration, and Device-to-Cloud (D2C) Integration.

UNIT 3: (~ 8 Lecture Hours)

Wireless Technologies for IoT Ecosystem: Introduction, Architecture for IoT Using Mobile Devices, Mobile Technologies for Supporting IoT Ecosystem, Energy Harvesting for Power Conservation in the IoT System, Mobile Application Development Platforms and Use of IoT, Low Power Wide Area Networking Technologies, Direct & Indirect Device Connectivity Topology of LPWAN, LoRaWaN.

UNIT 4: (~ 10 Lecture Hours)

Protocols for the IoT Ecosystem: Introduction, Layered Architecture for IoT, Protocol Architecture of IoT, Routing Protocol, IEEE 802.15.4, Bluetooth Low Energy, ZigBee, Protocols for IoT Service Discovery, Prominent IoT Service Discovery Products, IP Addresses, Infrastructure Protocols, Static IP Address Assignment, Dynamic IP Address Assignment, IPV6, TCP and UDP Ports, Application Layer Protocols.

Enablement Platforms for IoT Applications:

IoT Building Blocks, IoT or Sensor Data Gateway, Application Enablement Platforms, IoT Application Enablement Platforms, IoT and M2M Sensor Data Platform, IoT Data Analytics Platforms, IoT Data Virtualization Platforms, IoT Edge Data Analytics.

UNIT 5: (~ 10 Lecture Hours)

Integration Technologies of IoT: Introduction, IoT Portion for Smarter Enterprises and Environments, Sensor and Actuator Networks, IoT Device Integration Concepts, Device Profile for Web Services, Open Service Gateway, Scalability, Robustness, openHAB, Remote OSGi, Device Integration Protocols and Middleware, Data Distribution Bus, Message Queue Telemetry Transport, Extensible Messaging and Presence Protocol, Protocol Landscape for IoT.

Smart Use Cases of IoT:

Introduction, Collaboration Platforms, Geospatial Platforms, Open Access to Public Data, Smart Industrial Use Cases of IoT, Smart Lighting for Energy Conservation, Smart Transportation Systems, Smart Homes/Buildings, Smarter Homes-Middleware Platforms, Smart Education Systems Using Wearable Devices.

Text Books :

1. Y Pethuru Raj and AnupamaC.Raman, "The Internet of Things Enabling, Technologies, Platforms and Applications", CRC Press Taylor & Francis Group, 1st edition, 2017.
2. Adrain McEwen and Hakim Cassimally, "Designing the Internet of Things", Wiley 1st edition 2013.

Reference Books:

1. ArshdeepBahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press, 2013.
2. OvidiuVermesan, Peter Friess, "Internet of Things Applications: From Research and Innovation to Market Deployment", River Publishers Series in Communications, 2014.
3. Francis DaCosta, "Rethinking the Internet of Things: A Scalable Approachto Connecting Everything", 1st Edition, Apress Publications, 2013.

Online Resources:

1. https://www.tutorialspoint.com/internet_of_things/index.htm
   (Course Title: Internet of Things (IoT) Tutorial)
2. https://onlinecourses.nptel.ac.in/noc20_cs66/preview (Course: Introduction to IoT by Prof. Sudip Misra, IIT Kharagpur)

Course Outcomes(COs):

After completion of the course the students should be able to

CO1 Explain the basics of wireless and cloud technologies for IoT.

CO2 Get familiarity with the architectural features of D2D, M2M, cloud to device, and device to cloud interface in IoT.

CO3 Illustrate architecture of IoT using mobile technologies for supporting IoT ecosystem.

CO4 Distinguish between various protocols and integration technologies as applicable to IoT ecosystem.

CO5 Examine the use cases of communication and network topologies for IoT.

❄ ❄ ❄

M.Tech. I Year, II Sem **L T P C**
Course Code:522BR **3 0 0 3**

PRINCIPLES OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (PSE-4)

(Common to DECE, WMC)

Prerequisites: Nil

Course Objectives:

1. Become familiar with basic principles of AI toward problem solving using Search Strategy.
2. Illustrate AI and ML algorithms and their use in appropriate applications.
3. Able to formulate solutions to real time problems using machine learning algorithms.
4. Design and analyze various machine learning algorithms and techniques with a modern outlook focusing on advances.

UNIT 1: (~10 Lecture Hours)

Introduction: Definitions of AI, Foundations of AI, Subareas of AI.

Intelligent Agents: Agents & Environment, The Structure of Agents.

Solving Problems by Searching: Uninformed Search Strategies - Breadth-first search, Uniform-cost search, Depth-first search, Informed (Heuristic) Search Strategies, Greedy best-first search, A* search, Heuristic Functions, Hill climbing search.

Unit 2: (~10 Lecture Hours)

Adversarial Search: Optimal Decisions in Games, The minimax algorithm, Alpha-Beta Pruning, Constraint Satisfaction Problems.

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

UNIT 3: (~8 Lecture Hours)

Introduction to Machine Learning: Examples of Machine Learning Applications, Learning Associations, Classification, Regression, Unsupervised Learning, Reinforcement Learning.

Supervised Learning: Learning a Class from Examples, Vapnik-Chervonenkis Dimension, Probably Approximately Correct Learning, Noise, Learning Multiple Classes, Regression, Model Selection and Generalization, Dimensions of a Supervised Machine Learning Algorithm.

UNIT 4: (~8 Lecture Hours)

Artificial Neural Networks: Introduction, Appropriate problems for NN learning, Perceptrons, Multilayer Networks and Backpropagation Algorithm, Remarks on Backpropagation Algorithm, An example: Face recognition, Advanced topics of ANN-Error functions, Recurrent Networks.

UNIT 5: (~12 Lecture Hours)

Decision Trees: Introduction, Univariate Trees, Classification Trees, Regression Trees, Pruning, Rule Extraction from Trees, Learning Rules from Data, Multivariate Trees, Problems on Decision Tree.

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

Text Books:

1. Stuart Rusell, Peter Norving, Artificial Intelligence: A Modern Approach, Pearson Education 2nd Edition.
2. Tom M. Mitchell, Machine Learning. Mc Graw Hill Education. 1997.
3. Ethem Alpaydin, 'Introduction to Machine Learning', 3rd edition 2014.

Reference Books:

1. Elaine Rich, Kevin K and S B Nair, "Artificial Inteligence", 3rd Edition, McGraw Hill Education, 2017
2. Trevor Hastie, Robert Tibshirani & Jerome Friedman. "The Elements of Statistical Learning", Springer Series in Statistics, 2nd Edition 2001
3. Chrishtopher M.Bishop, "Pattern Recognition and Machine Learning", ISBN-13: 978-0387-31073-2, Springer, 2006.
4. Saroj Kaushik "Artifical Intelligence, Cengage Learning" 2011.

Online Resources:

1. Freebook online: Explorations in AI and Machine Learning by Prof. Roberto V. Zicari https://www.routledge.com/rsc/downloads/AI_FreeBook.pdf
2. https://nptel.ac.in/courses/106105077 (Course Title: Introduction to Artificial Intelligence, Prof. Anupam Basu, Prof. S. Sarkar, IIT Kharagpur)
3. https://nptel.ac.in/courses/106105077 (Course Title: Introduction to Machine Learning , Prof. S. Sarkar, IIT Kharagpur)

Course Outcomes(COs):

After completion of the course the students should be able to

CO1 Understand the basics of various search techniques and learning algorithms.
CO2 Apply various search algorithms for problem solving.
CO3 Analyze Bayesian Networks, Game playing and constraint optimization methods.
CO4 Compare neural network parameter optimization using Gradient descent optimization and compute error-function derivatives.
CO5 Analyse unsupervised, supervised and reinforcement learning.
CO6 Construct Neural Networks, Decision tree for problem solving.

❄ ❄ ❄

M.Tech.I Year, IISem **L T P C**
Course Code:522BS **3 0 0 3**

AD-HOC AND WIRELESS SENSOR NETWORKS

Prerequisites: Computer Networks

Course Objectives

The objectives of this course are to make the student

1. To study the fundamentals of Ad-Hoc and wireless sensor networks
2. To study the operation and performance of the protocols in wireless Ad-Hoc networks
3. To study the operation and performance of various routing protocols wireless sensor network.
4. To study the architecture and protocols of Wireless sensor networks.

Unit 1: (~10 Lecture Hours)

Introduction: Cellular and Ad Hoc Wireless Networks, Applications of Ad Hoc Wireless Networks, issues in Ad Hoc Wireless Networks. MAC Protocols for Ad Hoc Wireless Networks: Issues in designing a MAC Protocol for Ad Hoc Wireless Networks, Classifications of Mac Protocols: Contention-Based Protocols with reservation mechanisms and scheduling mechanism, MAC Protocols using Directional Antennas.

Unit 2: (~10 Lecture Hours)

Routing Protocols for Ad Hoc Wireless Networks: Issues in designing a routing protocol for Ad Hoc Wireless Networks, classifications of routing protocols, Table –Driven Routing Protocols, On Demand Routing Protocols, Hybrid Routing Protocols. Multicast Routing Protocols: Issues in Design of Multicast Routing Protocols, Classification of Multicast Routing Protocols, QoS Routing, Energy-Efficient Multicast Routing Protocols

Unit 3: (~9 Lecture Hours)

Transport Layer Protocols: Issues in Designing a Transport Layer Protocol for Ad Hoc Wireless Networks.

Security in Ad Hoc Wireless Networks: Network security requirement, Issues and challenges in security provisioning, network security attacks

Unit 4: (~10 Lecture Hours)

Wireless Sensor Networks: Introduction: Components of a wireless sensor node, Motivation for a Network of Wireless Sensor Nodes, Classification of sensor networks, Characteristics of wireless sensor networks, Challenges of wireless sensor networks, Comparison between wireless sensor networks and wireless mesh networks, Limitations in wireless sensor networks, Design challenges, Hardware architecture, Applications.

Node Architecture: The Sensing Subsystem, the Processor Subsystem, Communication Interfaces, Prototypes.

Unit 5: (~ Lecture Hours)

Medium Access Control Protocols for Wireless Sensor Networks

Introduction, Background, Fundamentals of MAC Protocols, Performance Requirements, Common Protocols, MAC Protocols for WSNs, Schedule-Based Protocols, Random Access-Based Protocols, Sensor-MAC Case Study, Protocol Overview, Periodic Listen and Sleep Operations, Schedule Selection and Coordination, Schedule

Synchronization, Adaptive Listening, Access Control and Data Exchange, Message Passing, IEEE 802.15.4 LR-WPANs Standard Case Study, PHY Layer, MAC Layer

Text books:

1. Ad Hoc Wireless Networks Architectures and Protocols C. Siva Ram Murthy and B.S. Manoj, Prentice Hall, 6th Edition, 2008.
2. WaltenegusDargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", Wiley 2010.
3. Kazem Sohraby, Daniel Minoli ,Taieb Znati," Wireless Sensor Networks, Technology, Protocols, and Applications" Wiley 2007
4. Wireless Ad- hoc and Sensor Networks: Protocols, Performance and Control - Jagannathan Sarangapani, CRC Press, Taylor & Francis Group,2007

References:

1. Ad Hoc and Sensor Networks Theory and Applications- Carols de Morais Cordeiro and Dharma Prakash Agrawal, World Scientific, 2006
2. Protocols and Architectures for Wireless Sensor Networks- Holger Karl and Andreas Willig John Wiley & Sons Ltd.,2005.
3. Ad Hoc Mobile Wireless Network Principles Protocols, and Applications, Second Edition, CRC Press, Taylor & Francis Group,2013.
4. Mohammad S. Obaidat, SudipMisra, "Principles of Wireless Sensor Networks", Cambridge, 2014.
5. Sunil Kumar, S. Manvi, Mahabalaseshwar, "Wireless & sensor mobile networks concepts and protocols" Wiley, 2010.

OnlineResources:

1. https://nptel.ac.in/courses/106106091 (CourseTitle :Computer Networks by Prof.A.Hema Murthy, IIT Madras
2. https://archive.nptel.ac.in/courses/106/105/106105160/(CourseTitle:Wireless Adhoc And Sensor NetworksbyProf. Sudeep Mishra, IIT Kharaghpur)

Course Outcomes (COs)

After completion of the course the student should be able to

CO1 Describe the basics of about Ad hoc Wireless Networks, and their applications.

CO2 Acquire the knowledge of MAC protocols in Ad-Hoc and Wireless Networks .

CO3 Examine the challenges and designing issues of a routing protocols for the application of a suitable algorithm based on the network and user requirement.

CO4 Analyze the design challenges, characteristics of wireless sensor networks and node architecture in Sensor Networks

CO5 Analyze the performance of various Medium Access Control Protocols of Wireless Sensor Networks .

❄ ❄ ❄

M.Tech. I Year, II Sem. **L T P C**
Course Code:52219 **0 0 3 1.5**

ARM MICROCONTROLLERS AND PROGRAMMABLE DIGITAL SIGNAL PROCESSORS LAB

(Professional Core Lab-3)

Prerequisites: 1. Microprocessors and Microcontrollers 2. Digital Signal Processing

Course Objectives:

1. To compare the features of ARM Cortex M3 and DSP C6748.
2. To experiment with the programming of ARM Cortex M3 and DSP C6748.
3. To utilize the instruction set of ARM Cortex M3.
4. To interpret the instruction set of DSP C6748.

Part A) Experiments to be carried out on Cortex-M3 development boards and using GNU tool chain.

Code Development for Part A:

1. Blink an LED with software delay, delay generated using the SysTick timer.
2. Using the PLL modules with System clock real time alteration.
3. Control intensity of an LED using PWM implemented in software and hardware.
4. Control an LED using switch by polling method, by interrupt method and flash the LED once every five switch presses.
5. UART Echo Test.
6. To take analog readings on rotation of rotary potentiometer connected to an ADC channel.
7. For temperature indication on an RGB LED.
8. To mimic light intensity sensed by the light sensor by varying the blinking rate of an LED.
9. To evaluate the various sleep modes by putting core in sleep and deep sleep modes.
10. System reset using watchdog timer in case something goes wrong.
11. To sample sound using a microphone and display sound levels on LEDs.
12. To display date and time using internal Real-Time Clock (RTC) programming.
13. To interface audio controller with Cortex-M3 based microcontroller.
14. To interface GSM module with Cortex-M3 based microcontroller.
15. To interface GPS module with Cortex-M3 based microcontroller.

Part B) Experiments to be carried out on DSP C6748 evaluation kits and using Code Composer Studio (CCS)

1. To develop and implement in assembly code and C code to computeEuclidian distance between anytwo points.
2. To develop and implement in assembly code and study the impact ofparallel, serial and mixed execution.
3. To develop and implement in assembly and C code for implementation of convolution operation.
4. To design and implement filters in C to enhance the features of giveninput sequence/signal.

Note: Minimum of 12 experiments to be conducted (Minimum of 2 from Part B)

Online Resources:

1. http://nptel.ac.in/courses/108102045
2. http://nptel.ac.in/courses/117106111**(**ARM based development by Prof. S. Chandramouleeswaram, IIT Madras)
3. Technical reference manuals from www.arm.com, www.ti.com

Course Outcomes(COs):

After completion of the course the students should be able to

CO1 Define and label the instruction sets of Cortex-M3 and TMS320C6748 DSP processors.

CO2 Classify and configure the instruction sets for Cortex-M3 and TMS320C6748 DSP processors, and outline the codes for application development.

CO3 Develop prototype code for on-chip and off-chip peripherals on Cortex-M3 development boards using the Keil ARM IDE tool.

CO4 Build prototype code for on-chip and off-chip peripherals on TMS320C6748 development boards using the CCS IDE tool.

CO5 Analyze the various peripherals interfacing with the Cortex-M3 processor.

CO6 Develop and implement codes for mathematical operations and filtering applications using TMS320C6748 DSP processor with CCS tool.

❄ ❄ ❄

M.Tech. I Year, II Sem **L T P C**
Course Code:52220 **0 0 3 1.5**

ADVANCED COMMUNICATION NETWORKS LABORATORY

Course Objectives:

1. Implement practically the networking commands.
2. Accomplish network configuration.
3. Analyze Quality of Service concepts.

List of Experiments:

1. Study of Networking Commands (Ping, Tracert, TELNET, nslookup, netstat, ARP, RARP) and Network Configuration Files.
2. Linux Network Configuration
   a) Configuring NIC's IP Address.
   b) Determining IP Address and MAC Address using if-config command.
   c) Changing IP Address using if-config.
   d) Static IP Address and Configuration by Editing.
   e) Determining IP Address using DHCP.
   f) Configuring Hostname in /etc/hosts file.
3. Implementation of VLAN trunking protocol in GNS3 Understanding IP addresses and Configuration of static routing in GNS3.
4. Configuration of RIP, OSPF routing protocols in GNS3.
5. Configuration of Network Address Translation (NAT) in GNS3
6. Find shortest paths through provider network for RSVP and BGP
7. Implementation of IPv6 Tunneling over IPv4 in GNS3.
8. Implementation of Weighted Fair Queueing in GNS3.
9. Understand configuration, forwarding tables, and debugging of MPLS in GNS3.
10. Implementation of MPLS Label Distribution Protocol (LDP) in GNS3.
11. Implementation of Multilink PPP Link Fragmentation and Interleaving over Frame Relay in GNS3
12. Implementation of NTP (Network Time Protocol) for network synchronization in GNS3

Online Websites/ Materials:

1. https://onlinecourses.nptel.ac.in/noc18_cs38/preview: Sowmya K. Ghosh & Sandip Chakraborthy
2. https://gns3.teachable.com/

CourseOutcomes(COs)

After completion of the course the student should be able to

CO1 Outline the concepts of different layers in TCP/IP protocol suite.

CO2 Infer the concepts of networking commands, IP addresses for basic network configuration

CO3 Apply interior gateway routing protocols such as RIP, OSPF and exterior gateway routing protocols like BGP attain full network connectivity.

CO4 Analyze the performance of the routing protocols such as RIP, OSPF and BGP and acquaint with the concepts of QoS such as MPLS and Traffic Engineering

CO5 Design the network for given specifications.

M.Tech. II Year, I Sem **L T P C**
Course Code:523BT **3 0 0 3**

MIMO SYSTEMS
(Program Specific Elective-5)

Prerequisites: Wireless Communications

Course Objectives:

1. To understand basic requirement of MIMO systems.
2. To develop channel modeling for MIMO systems.
3. To calculate capacity for MIMO systems.
4. To study multiplexing capabilities and architectures of MIMO systems.

UNIT 1: (~ 9 Lecture Hours)

Point-to-Point Communication: Detection and Diversity

Detection in a Rayleigh Fading Channel – Noncoherent Detection, Coherent Detection, From BPSK to QPSK: Exploiting the Degrees of Freedom, Diversity. Time Diversity – Repetition Coding, Time Diversity in GSM. Antenna Diversity – Receiver Diversity, Transmit Diversity - Space-Time Codes, MIMO. Frequency diversity – Basic Concept, Single-Carrier with ISI Equalization, Direct Sequence Spread Spectrum.

UNIT 2: (~ 9 Lecture Hours)

Capacity of Wireless Channels: AWGN Channel Capacity - Repetition Coding, Packing Spheres. Linear Time-Invariant Gaussian Channels, Single Input Multiple Output (SIMO) Channel, Multiple Input Single Output (MISO) Channel, Frequency-Selective Channel. Capacity of Fading Channels – Slow Fading Channel, Receive Diversity, Transmit Diversity, Time and Frequency Diversity, Fast Fading Channel, Transmitter Side Information, Frequency-Selective Fading Channels.

UNIT 3: (~ 10 Lecture Hours)

Spatial Multiplexing and Channel Modeling: Multiplexing Capability of Deterministic MIMO Channels – Capacity via Singular Value Decomposition, Rank and Condition Number. Physical Modeling of MIMO Channels, Line-of-Sight SIMO channel, Line-of-Sight MISO channel, Antenna Arrays with only a Line-of-Sight Path, Geographically Separated Antennas, Line-of-Sight Plus One Reflected Path. Modeling of MIMO Fading Channels – Basic Approach, MIMO Multipath Channel, Angular Domain Representation of Signals, Angular Domain Representation of MIMO Channels, Statistical Modeling in the Angular Domain, Degrees of Freedom and Diversity, Dependency on Antenna Spacing, IID Rayleigh Fading Model.

UNIT 4: (~ 9 Lecture Hours)

Capacity and Multiplexing Architectures: The V-BLAST Architecture. Fast fading MIMO Channel – Capacity with CSI at Receiver, Performance Gains, Full CSI. Receiver Architectures – Linear Decorrelator, Successive Cancellation, Linear MMSE Receiver, Information Theoretic Optimality. Slow Fading MIMO Channel. D-BLAST: an Outage-Optimal Architecture – Sub-Optimality of V-BLAST, Coding Across Transmit Antennas: D-BLAST.

UNIT 5: (~ 8 Lecture Hours)

Multiuser Communication: Uplink with Multiple Receive Antennas – Space-Division Multiple Access, SDMA Capacity Region, System Implications, Slow Fading, Fast Fading, Multiuser Diversity Revisited. MIMO uplink – SDMA with Multiple Transmit Antennas, System Implications, Fast Fading. Downlink with Multiple Transmit Antennas, Degrees of Freedom in the Downlink.

Text Books:

1. David Tse, and Pramod Viswanath, "Fundamentals of Wireless Communication", 1st edition, Cambridge University Press, 2014.
2. Mohinder Janakiraman, "Space - Time Codes and MIMO Systems", Artech House Publishers, 2004.

Reference Books:

1. Claude Oestges, and Bruno Clerckx, "MIMO Wireless Communications: From Real-world Propagation to Space-time Code Design", Academic Press, 1st edition, 2010.
2. Togla M. Duman, and Ali Ghrayeb, "Coding for MIMO Communication Systems", John Wiley & Sons Ltd, 2007.
3. Hamid Jafarkhani, "Space Time coding –Theory and Practice", Cambridge university press, 2005.

Online Resource:

http://nptel.ac.in/courses/117105132/

(Course Title: Fundamentals of MIMO Wireless Communication, Prof. Surva Sekhar Das, IIT Kharagpur)

Course Outcomes(COs):

After completion of the course the student should be able to

CO1 Describe Basic Features of Coherent and Noncoherent Detection, Fading and Nonfading Channels and their Capacities, Diversity Techniques and Space-Time Codes.

CO2 Differentiate Between Different MIMO Configuration Systems, and Interpret Multi Symbol Transmission using Spatial Multiplexing and Channel Modeling.

CO3 Calculate Channel Capacities of Various Fading and Nonfading Channels in MIMO Systems and Interpret the Effects of Diversity Techniques.

CO4 Analyze the V-BLAST and D-BLAST Types of Architectures and to Compare BER and Channel Capacity Estimates.

CO5 Evaluate Performance Characteristic for Multiuser Communication in MIMO Systems under Different Channel Conditions for Uplink and Downlink.

❄ ❄ ❄

M.Tech. II Year, II Sem **L T P C**
Course Code:523BU **3 0 0 3**

SYSTEM ON CHIP ARCHITECTURE
(Professional Elective-5)

Prerequisites: 1. Microprocessors and Microcontrollers 2. VLSI Design

Course Objectives:

1. To Understand the System Architecture.
2. To Compare Different Memory Designs
3. To Interpret the Architectures and Applications of Various Interconnect Buses.
4. To Apply the Knowledge of SoC Design in Different Applications.

UNIT 1: (~9 Lecture Hours)

Introduction to the System Approach: System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory, and Addressing. System level interconnection, An approach for SoC Design, System Architecture and Complexity.

UNIT 2: (~8 Lecture Hours)

Processors: Introduction , Processor Selection for SoC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.

UNIT 3: (~12 Lecture Hours)

Memory Design for SoC: Overview of SoC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D –Caches, Multilevel Caches, Virtual to real translation, SoC Memory System, Models of Simple Processor – memory interaction.

UNIT 4: (~9 Lecture Hours)

Interconnect Customization and Configuration: Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses, Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time. SoC Customization: An overview, Customizing Instruction Processor, Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance Specific design, Customizable Soft Processor, Reconfiguration - overhead analysis and trade-off analysis on reconfigurable Parallelism.

UNIT 5: (~10 Lecture Hours)

Application studies and Case Studies: SoC Design approach, AES algorithms, Design and evaluation, Image compression – JPEG compression

Text Books:

1. Michael J. Flynn and Wayne Luk, "Computer System Design System on Chip", Wiley India Pvt. Ltd. October, 2011.
2. Steve Furber, "ARM System on Chip Architecture", Addison Wesley Professional 2nd Ed., 2000.

Reference Books :

1. Ricardo Reis, "Design of System on a Chip: Devices and Components", 1st Ed, Springer Publishers, 2004.
2. Jason Andrews, "Co-Verification of Hardware and Software for ARM Systemon Chip Design (Embedded Technology)", 1st Ed, Elsevier publications, 2004.

Online Resources

1. https://nptel.ac.in/courses/106103183 (Course Title: Multi-Core Computer Architecture by Prof.John Jose, IIT Guwahati)
2. https://freevideolectures.com/course/2341/embedded-systems/10 (CourseTitle: Embedded Systems by Prof. Santanu Chaudhary ,IIT Delhi)

Course Outcomes(COs):

After completion of the course the student should be able to

CO1 Describe the Interconnection Strategies and their Customization on SoC.

CO2 Acquire the Knowledge of All the Components Required for System Design and Memory Architectures on SoC.

CO3 Evaluate the Performance of a System on Chip by Minimizing the Delays.

CO4 Develop Analytical Skill for Deciding the Type of Processor Required to Design a SoC for the required Application.

CO5 Develop a Configurable Device Based on the Application Requirement for aSystem on Chip.

❄ ❄ ❄

M.Tech. II Year, II Sem. **L T P C**
Course Code: 523BV **3 0 0 3**

EMBEDDED NETWORKING

(Program Specific Elective-5)

Prerequisites: 1. Embedded Systems.

Course objectives:

1. To understand the wired and wireless embedded communication protocols.
2. To study the basics of ethernet and embedded ethernet.
3. To discuss the wireless embedded networkingprotocols.
4. To infer the issues in networked embedded system development.

UNIT 1: (~ 10 Lecture Hours)

Embedded Communication Protocols: Embedded Networking: Introduction– Serial/Parallel Communication–Serial Communication Protocols-RS232 standard–RS485–Synchronous Serial Protocols-Serial Peripheral Interface (SPI)–Inter Integrated Circuits (I2C)–PC Parallel port programming–ISA/PCI Bus protocols–Fire wire.

UNIT 2: (~ 10 Lecture Hours)

USB and CAN Bus: USB bus–Introduction–Speed Identification on the bus– USB States–USB bus communication: Packets–Data flow type–Enumeration–Descriptors–PIC 18 Microcontroller USB Interface–C Programs–CAN Bus– Introduction–Frames–Bit stuffing–Types of errors–Nominal Bit Timing–PIC microcontroller CAN Interface–A simple application with CAN.

UNIT 3: (~ 8 Lecture Hours)

Ethernet Basics: Elements of a network–Inside Ethernet–Building a Network: Hardware options–Cables, Connections and network speed–Design choices: Selecting components–Ethernet Controllers–Using the internet in local and internet communications–Inside the internet protocol.

UNIT 4: (~ 8 Lecture Hours)

Embedded Ethernet: Exchanging messages using UDP and TCP–Serving web pages with Dynamic Data–Serving web pages that respond to user Input–Email for Embedded Systems–Using FTP–Keeping Devices and Network secure.

UNIT 5: (~ 9 Lecture Hours)

Wireless Embedded Networking: Wireless sensor networks–Introduction– Applications–Network Topology–Localization–Time Synchronization–Energy efficient MAC protocols–SMAC–Energy efficient and robust routing–Data Centric routing.

Text Books :

1. K.V. Sibhu, "Introduction to Embedded Systems", 2nd Edition, 2017.
2. Jan Axelson, "Embedded Ethernet and Internet Complete", Penram Publications, 2003.
3. Bhaskar Krishnamachari, Networking Wireless Sensors", Cambridge press 2005.

Reference Books:

1. Dogan Ibrahim, "Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18F series", Elsevier 2008.
2. Jan Axelson, "Parallel Port Complete: Programming, interfacing and using the PCs parallel printer port",Penram Publications, 1996.
3. Frank Vahid, Tony Givargis, "Embedded Systems Design: A Unified Hardware/Software Introduction", John & Wiley Publications, 2002.
4. Dawoud Shenouda Dawoud and Peter Dawoud, "Serial Communication Protocols and Standards", River Publications, July 2020.
5. Dawoud Shenouda Dawoud and Peter Dawoud, "Microcontroller and Smart Home Networks", River Publications, July 2020.

Online Resources:

1. http://www.infocobuild.com/education/audio-video-courses/electronics/EmbeddedSystems-IIT-Delhi/lecture-24.html (Course Title: Embedded systems by Prof. SantanuChaudhury, IIT Delhi)
2. https://nptel.ac.in/courses/108102045 (Course Title: Embedded systems by Prof. SantanuChaudhury, IIT Delhi)
3. http://www.nitttrc.edu.in/nptel/courses/video/108102045/lec1.pdf(Tutorials on Embedded systems by Prof. SantanuChaudhury, IITDelhi)
4. http://kishorekumarbooks.blogspot.com/2019/04/embedded-networking-notes.html(Tutorials on Embedded Networking)

Course Outcomes(COs):

After completion of the course the students should be able to

CO1 Narrate the features of embedded networking, basics of ethernet communication and outline the serial, parallel, and wireless communication protocols.

CO2 Distinguish between USB and CAN bus protocols for embedded system applications.

CO3 Implement the TCP and UDP protocols for client and server model in networked embedded systems.

CO4 Apply the wireless protocols in real world interfacing.

CO5 Develop a networked embedded system for real time applications.

I Year M.Tech. I-Semester **L T P C**
Course code:52174 **2 - - -**

ENGLISH FOR RESEARCH PAPER WRITING

(Audit Course-1)

Prerequisites: Nil

Course Objectives:

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

UNIT 1: (~ 7 Lecture Hours)
Academic Writing
What is Research? - Meaning & Definition of a research paper– Purpose of a research paper – Scope – Benefits – Limitations – outcomes.

UNIT 2: (~ 7 Lecture Hours)
Research Format
Title – Abstract – Introduction – Discussion – Findings – Conclusion – Style of Indentation – Font size/Font types – Indexing – Citation of sources.

UNIT 3: (~ 6 Lecture Hours)
Research Methodology
Methods (Qualitative – Quantitative) – Literature Review – Who did what – Criticizing, Paraphrasing & Plagiarism.

UNIT 4: (~ 6 Lecture Hours)
Process of Writing a research paper
Choosing a topic - Thesis Statement – Outline – Organizing notes – Language of Research – Word order, Paragraphs – Writing first draft –Revising/Editing- Typing the final draft

UNIT 5: (~ 6 Lecture Hours)
How to & where to get published
Reputed Journals – National/International – ISSN No, No. of volumes, Scopes Index/UGC Journals – Free publications - Paid Journal publications – /Advantages/Benefits

Reference Books:

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

Online Resources:

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

Course Outcomes:

After completion of the course, students will be able to

CO1 Understand the nuances of research writing.
CO2 Write a research paper with required writing skills and be confident to share their writing with others.
CO3 Publish a paper using the requisite standard in a journal.
CO4 Review the research papers and articles in a scientific manner.
CO5 Work on citations and ably place them in her research paper.
CO6 Avoid plagiarism with an ability to develop her own writing skills in presenting the research work.

❄ ❄ ❄

I Year M.Tech – I - Semester **L T P C**
Course code: **2 0 0 0**

DISASTER MANAGEMENT (AC-1)

(Common to PEED, DECE, CSE, CNIS, WMC)

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 -I: (~8Lecture Hours)

Introduction and Repercussions of Disasters and Hazards: Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude. Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT II: (~5Lecture 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 III: (~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. Disaster Management Cycle.

UNIT IV: (~5Lecture Hours)

Risk Assessment Disaster Risk: Concept and Elements, Disaster Risk Reduction, People's ParticipationRisk Assessment, Strategies for Survival, Case Studies of Global, National and Local disasters, Techniques of Risk reduction for different disasters.

UNIT V: (~5Lecture Hours)

Disaster Risk Reduction & Mitigation: Meaning, Environment Security, Climate Change & Security risks, Climate Security Mechanism, Environmental Cooperation and Peace Building, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation - Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.Role of NDMA in Disaster Mitigation in India.

Text Books:

1. R.Nishith,Singh A.K,. "Disaster Management in India: Perspectives, Issuesand 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.2005Basic Principles of Disaster Medical Management. Act Anaesth. Belg; 56:395-40.
5. Aim and Scope of Disaster Management. Study Guide prepared by Sharman and Hansen. UW-DMC, University of Washington.
6. UNEP.org - ECO – DRR

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
7. https://www.unep.org/explore-topics/disasters-conflicts/what-we-do/disaster-risk-reduction/ecosystem-based-disaster-risk

COURSE OUTCOMES(COs):

After completion of the course, students will be able to

CO1 Acquire the knowledge of different disasters and measures to reduce the risk due to these disasters.

CO2 Plan institutional framework for disaster management at national as well as global levels.

CO3 Analyze, evaluate and manage the different public health aspects of disaster events at local and global levels, even when limited information is available.

CO4 Develop capacity to describe, the environmental, social, cultural, economic, legal and organizational aspects influencing vulnerabilities and capacities to face disasters.

CO5 Acquire the knowledge on emergency/disaster management cycle for various types of disasters.

CO6 Develop a basic understanding of prevention, mitigation, preparedness, response and recovery on various types of disasters.

I Year M.Tech. II-Semester **L T P C**
Course code: **2 - - -**

SANSKRIT FOR TECHNICAL KNOWLEDGE [STK]

(Audit Course)

Prerequisites: Nil

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)

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.

Suggested Reading:

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

Course Outcomes (COs)

After completion of the course, students will be able to

CO1 Gain knowledge in basic SANSKRIT language.
CO2 Understand the ancient SANSKRIT literature about Science & Technology.
CO3 Develop logical and analytical skills.

I Year M.Tech. II-Semester **L T P C**
Course code: **2 - - -**

VALUE EDUCATION

(Audit Course)

Prerequisites: Nil

Course Objectives:

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.

Online Resources:

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

Course Outcomes(COs)

After completion of the course, students will be able to

CO1 Gainknowledgeonself-development.
CO2 LearntheimportanceofHumanValues.
CO3 Developoverallpersonality.
CO4 Understand the importance of value education to build tolerance and harmony at different layers.
CO5 Identify the ways for self-development.
CO6 Identify the basic values and principles to guide one's own life.

I Year M.Tech. II-Semester **L T P C**
Course code: **2 - - -**

CONSTITUTION OF INDIA

(Audit Course)

Prerequisites: NIL

Course Objectives:

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

UNIT 1: (~8 Lecture Hours)

HISTORY OF MAKING OF THE INDIAN CONSTITUTION & PHILOSOPHY OF THE INDIAN CONSTITUTION HISTORY OF MAKING OF THE INDIAN CONSTITUTION

History, Drafting Committee (Composition & Working) **Philosophy of the Indian Constitution**: Preamble, Salient Features.

UNIT 2: (~ 6 Lecture Hours)

CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

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

UNIT 3: (~ 6 Lecture Hours)

ORGANS OF GOVERNANCE

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

UNIT 4: (~ 6 Lecture Hours)

LOCAL ADMINISTRATION

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Panchayati Raj : Introduction, PRI : ZilaPanchayat, Elected officials and their roles, CEO ZilaPanchayat: Position and role, Block Level : Organizational Hierarchy (Different departments), Village level : Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT 5: (~ 6 Lecture Hours)

ELECTION COMMISSION

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

Reference Books:

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

Online Resources:

1. https://nptel.ac.in/courses/129106003 [Constitutional Studies by Prof. Sudhir Krishna Swami, IIT Madras]
2. https://onlinecourses.swayam2.ac.in/cec20_hs38/preview [Indian Government and Politics by Dr.Aijaz Ashraf Wani, University of Kashmir, Srinagar]

CourseOutcomes:

After completion of the course, students will be able to

CO1 TellaboutfunctionofIndianconstitution withclarityand understanding.
CO2 Identifythe Rightsofequality, theRight offreedomand theRight toconstitutionalremedies
CO3 Marktheknowledgeofuniongovernment&theirpowersandfunction.
CO4 Definethestateandcentralpolicies,fundamentalduties
CO5 ExplainthepowersandfunctionsofMunicipalities,PanchayatsandCo-operativeSocieties
CO6 DiscusstheElectoralProcess,specialprovisions

Assessment Criteria:

SATISFACTORY PARTICIPATIONCERTIFICATE shall be issued only after securing greater than or equivalent to **75%** of the attendance in the course along with the active Classroom interaction and participation by the students.

❄ ❄ ❄

I Year M.Tech. I-Semester **L T P C**
Course code: **2 - - -**

PEDAGOGY STUDIES

(Audit Course-1)

Prerequisites: Nil

Course Objectives:

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

UNIT 1: (~ 8 Lecture Hours)

Introduction and Methodology:

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

UNIT 2: (~ 6 Lecture Hours)

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

UNIT 3: (~ 6 Lecture Hours)

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

UNIT 4: (~ 6 Lecture Hours)

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

UNIT 5: (~ 6 Lecture Hours)

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

Reference Books:

1. Ackers J, Hardman F (2001) Classroom Interaction in Kenyan Primary Schools, Compare, 31 (2): 245 – 261.
2. Agarwal M (2004) Curricular Reform in Schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3) : 361 – 379.
3. Akyeampong K, (2003) Teacher Training in Ghana – does it count? Multisite teacher education research project (MUSTER) Country Report 1.London: DFID
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of Basic Maths and Reading in Africa: Does teacher Preparation count? International Journal Educational Development, 33 (3): 272- 282.
5. Alexander R (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:

After completion of the course the student should be able to

1. The pedagogical practices followed by teachers in developing countries both informal and informal classrooms.
2. Examine the effectiveness of pedagogical practices.
3. Understand the concept, characteristics and types of educational research and perspectives of research.
4. Importance of the role of teacher education, school curriculum and guidance materials for effective pedagogy.
5. Identify the critical evidence gaps in teaching – learning and to develop strategic plan to fill the gaps.
6. Develop appropriate resources in alignment with the curriculum and its objectives.

❄ ❄ ❄

I Year M.Tech. II-Semester **L T P C**
Course code: **2 - - -**

STRESS MANAGEMENT BY YOGA [SMT]

(Audit Course)

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: (~ 8 Lecture Hours)

Asanas:: (5 Asanas in ach posture)

- Warm up
- Standing Asanas
- Sitting Asanas
- Prone Asanas
- Supine asanas
- Surya Namaskar

UNIT 5: (~ 8 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)

Suggested Reading:

1. Andrews, Linda Washer (2005) Stress control for peace of mind, London: Greenwich Editions.
2. Author's Guide -Yoga- The science of Holistic Living, Chennai: The Vivekananda Kendra Prakashan trust.
3. Iyengar BKS (2003) The art of Yoga, New Delhi: Harper Collins Publishers.
4. Lalvani, Vimla ((1998) Yoga for Stress, London: Hamlyn.
5. Maguire,Imelda 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.

Reference Books:

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

CourseOutcomes:

After completion of the course the student should 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.
5. Integrate Yoga into one's lifestyle.
6. Learn to practice the basic concepts of yoga to manage stress.

❄ ❄ ❄

I Year M.Tech. I-Semester **L T P C**
Course code: **2 - - -**

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

(Audit Course-1)

Prerequisites: Nil

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 - ShrimadBhagawadGeeta: 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 Bhagawat Geeta.

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

Online Resources:

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

CourseOutcomes:

After completion of the course the student should be able to

CO1 Developtheirpersonalityandachievetheirhighestgoaloflife.
CO2 Leadthenationandmankindtopeaceandprosperity.
CO3 Developversatilepersonality.
CO4 Harmonize peace and mental well-being to handle day-to-day works more productively.
CO5 Understand oneself for holistic development.
CO6 Explore one's own potential to enhance their productive work.

II Year M.Tech. I-Semester **L T P C**
Course Code: **3 0 0 3**

BUSINESS ANALYTICS

(Open Elective)

Pre-requisites: Nil

Course Objectives:

1. To understand the role of business analytics within an organization.
2. To gain an understanding in usage of business analytics in formulating and solving problems using analytical and management tools in managerial decision making.
3. To 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: (~08 Lecture Hours)

Introduction to Business Analytics

Introduction to Analytics - Importance of Analytics in Problem analytics - Business Analytics - Importance - Difference between Business Analytics and Business Intelligence - Evolution of Business Analytics - Types of Business Analytics - Characteristics - Goals - Domains of Business Analytics - Framework of Business Analytics - Analytics Ecosystem - Process - advantages - steps of Decision modeling for Business Analytics.

UNIT 2: (~09 Lecture Hours)

Organization Structure and Data for Business Analytics

Organization Structure of Business Analytics - Functional organization - Matrix - centralized structure with Business Analytics - Factors determining in choosing appropriate structure - Reasons for organizational failure for Business Analytics Initiatives - Team Management - Reasons for Team failure

Data - Characteristic of Readiness of data Dimensions - Data taxonomy - Data mining - Process - Implications of Data outlines -Steps in data driven decision making - Importance of sampling - Data visualization - Types of Data Storytelling - Data Journalism - Data warehousing.

UNIT 3: (~10 Lecture Hours)

Descriptive Analytics

Introduction to Descriptive Analytics, Measure of Central tendency-Mean, Median, Mode Measure of Variation-Variance, Standard deviation, Mean Deviation, Interquartile Deviation Measure of Shape-Kurtosis, Skewness, Measure of Association-Covariance, Correlation Random Variables: Discrete probability Distribution and Continuous Probability Distribution (Mean, Median, Mode)

UNIT 4: (~10 Lecture Hours)

Predictive and Prescriptive Analytics

Predictive Analytics- Regression- Simple linear regression, Multiple linear regression-Test of significance of regression coefficients Using ANOVA (one way and twoway classification), Coefficient of Determination. Forecasting -Time Series Analysis- Trend Analysis, Moving Average Method, ARMA Model with error Analysis.

Prescriptive Analytics: Linear Programing Problem- Graphical Method, Simplex Method

UNIT 5: (~08 Lecture Hours)

Decision Analysis

Problem Formulation, Decision analysis without probabilities, Decision analysis with probabilities, Decision Analysis with sample information, Computing Branch Probabilities with Bayes Theorem, Utility Theory.

Text Books:

1. Ramesh Sharada, Dursun Delen, Efraim Turban and David King, Business Intelligence, Analytics, and Data Science - A Managerial Perspective, Pearson, 4th Edition.
2. U Dinesh Kumar, Business Analytics - The Science of Data-Driven Decision Making, Wiley, 2nd Edition.

References:

1. Gert H.N. Laursen and Jesper Thorlund, Business Analytics for Managers - Taking Business Intelligence Beyond Reporting, Wiley, 2nd Edition.
2. Camm, Cochran, Fry, Ohlmann, anderson, Sweeney and Williams: Essentials of Business Analytics, Cengage Publishers

Online Resources:

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

Course Outcome:

After completion of the course, students will be able to

CO1 Understand and apply business analytics in real time world.
CO2 Comprehend the structure of an organization for business analytics implementation.
CO3 Identify the befitting descriptive tool required for the business problem.
CO4 Apply suitable predicative method that supports business decision making.
CO5 Identify appropriate prescriptive modeling techniques for decision making.
CO6 Translate data into clear, actionable insights in the decision-making process.

❄ ❄ ❄

II Year M.Tech., I-Semester **L T P C**
Course Code: **3 0 0 3**

INDUSTRIAL SAFETY

(Open Elective)

Pre-requisites: Industrial Management

Course Objectives:

1. Concepts of industrial safety and provide useful knowledge for work place safety.
2. Understand Industrial Safety Programs, Fire explosions and its Preventive methods.
3. Helps in identification, evaluation and control of the hazards.
4. Mitigate harm to people, property and the environment.
5. Quality maintenance process, Duties & Responsibilities of Safety officer's.
6. Overhauling of Mechanical & Electrical machinery components, difference between Periodic & Preventive Maintenance.

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.

UNIT 2: (~10 Lecture Hours)

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

UNIT 3: (~10 Lecture Hours)

Fundamentals of maintenance engineering: Definition of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, types of maintenance, maintenance cost and its relations with replacement economy, service life of equipment.

UNIT 4: (~8 Lecture Hours)

Quality and safety in maintenance: needs for quality maintenance process, maintenance work quality, use of quality control, 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:(~10 Lecture Hours)

Types of maintenance: corrective, breakdown, predictive, replacement, preventive and proactive maintenance.

Periodic and preventive maintenance in details: Periodic maintenance: inspection- concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motors, common troubles and remedies of electric motor , repair complexities and its use

Preventive maintenance: definition, needs, steps and advantages.

Textbooks:

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 & Morrow, Maintenance Engineering Handbook, Da Information Services.
3. Mc Cornick, E.J., Human Factors in Engineering and design, Tata McGraw-Hill, 1982

Online websites/ Materials:

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

Course Outcomes:

After completion of the course, students will 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.

❄ ❄ ❄

II Year M.Tech., I-Semester **L T P C**
Course Code: **3 0 0 3**

OPERATIONS RESEARCH

(Open Elective)

Pre-requisites: -

Course objectives:

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

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

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

Inventory models. Inventory costs. Models with deterministic demand-model (a) demand rate uniform and production rate infinite, model (b) demand rate uniform and production rate finite.

UNIT 4: (~10Lecture Hours)

Games Theory. Competitive games rectangular game saddle point, minimax (maximin) method of optimal strategies, and value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point-mixed strategy for 2*2 games.

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

UNIT 5: (~ 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

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 Text 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.

Course outcomes

After completion of the course, students will be able to

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

❄ ❄ ❄

II Year M.Tech., I-Semester **L T P C**
Course Code: **3 0 0 3**

COST MANAGEMENT OF ENGINEERING PROJECTS

(Open Elective)

Pre-requisites: Nil

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: (~08 Lecture Hours)

INTRODUCTION TO PROJECT MANAGEMENT

Project- Need of Project Management- Objectives -Scope- Importance of Project Management - Principles of Project Management- Types of Projects-Roles and Responsibilities of Project Team.

UNIT 2: (~09 Lecture Hours)

PROJECT PLANNING AND IMPLEMENTATION

Project Management Life Cycle-Process-Project Selection – Feasibility study: Types of feasibility - Steps in feasibility study- Estimation of Project cost – Cost of Capital – Project Representation and Preliminary Manipulations – Basic Scheduling Concepts - Resource Levelling – Resource Allocation-Execution.

UNIT 3: (~08 Lecture Hours)

COST MANAGEMENT FOR PROJECTS

Introduction and importance of Cost Management for Projects- Objectives of Costing System -Various cost concepts- 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).

UNIT 4: (~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 (Simple Problems on Functional based budget). Introduction to Zero based budgeting.

UNIT 5: (~10 Lecture Hours)

PROJECT-COST MANAGEMENT

Project Cost Estimation- Project Financing- Project Planning and Scheduling-Project Cost Control-Quantitative Techniques for Project Cost Management-Linear Programming-Network Analysis-PERT/CPM-Project Cost Analysis-Transportation Model-Assignment Model (Simple Problems)- Simulation-Learning Curve Theory-Project Methodologies -Types-Project Integrated Management (PIM).

Text Books:

1. K.Nagarajan, Project Management, New Age International Publishers.
2. L. S. Srinath, PERT and CPM Principles and Applications.
3. Charles T. Horngren and George Foster, Cost Accounting: A Managerial Emphasis, PHI, 1st Edition.

References:

1. Arun Kanda, Project Management A Life Cycle Approach, Prentice Hall of India, 2011
2. R.B.Khanna, Project Management, Prentice Hall of India, 2011
3. R.Panneerselvam and P.Senthilkumar, Project Management, Prentice Hall of India, 2009
4. Blocher, Chen, Cokins, and Lin, Cost Management: A Strategic Emphasis.
5. John K. Shank and Vijay Govindarajan, Strategic Cost Management.

Online Resources:

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

Course Outcomes:

After completion of the course, students will be able to

1. Perceive the cost associated in managing engineering projects
2. Develop Project Planning proposal considering time and cost
3. Furnish effective cost management practices for better handling of engineering projects
4. Prepare budgets for engineering projects.
5. Propose the Quantitative Techniques for Project Cost Management.
6. Orient the cost management decision-making using quantitative methodology in minimizing the cost associated with the projects.

❄ ❄ ❄

II Year M.Tech., I-Semester **L T P C**
Course Code: **3 0 0 3**

COMPOSITE MATERIALS

(Open Elective)

Pre-requisites: Nil

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 Behaviour 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 – VCH, Material Science and Technology – Vol 13 – Composites, West Germany.
2. R. Bala subramaniam, Callister's Materials Science and Engineering, An introduction, John Wiley & Sons, NY, Indian Edition, 2007.

Reference books:

1. ed-Lubin, Hand Book of Composite Materials.
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.

Web resources:

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

Course Outcomes:

After completion of the course, students will be able to

CO1 Differentiate composite materials and their applications.

CO2 Analyse, evaluate and manage the different the types of reinforcements.

CO3 Develop different types of metal matrix composites and prepare the same for their specific needs as engineers.

CO4 Develop different types of ceramic matrix composites and prepare the same for their specific needs as engineers.

CO5 Develop different types of polymer matrix composites and prepare the same for their specific needs as engineers.

CO6 Critically enhance strength of the composite materials through laminar usage.

❄ ❄ ❄

II Year M.Tech., I-Semester **L T P C**
Course Code: **3 0 0 3**

ENERGY FROM WASTE

(Open Elective)

Pre-requisites:

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.

UNIT 1: (~8 Lecture Hours)

Classification of waste – Agro based, Domestic, Bio-Medical, Forest residue, Industrial waste, recycling of waste, Segregation of waste, waste treatment, Environmental impacts. Land fill method for disposal of waste, Landfill classification.

Guidelines for Minimization of Wastage in Society (Individual houses, Apartments, Industries etc.)-Reduce, Reuse & Recycle. Minimization of all types of wastage through Orientation programs, Awareness camps, workshops, seminar etc.

Group Discussion Activity (~2 Lecture Hours)

UNIT 2: (~9 Lecture Hours)

Biomass: Pyrolysis – Byproducts of Pyrolysis– Manufacture of pyrolytic oils and gases, applications. Biomass Gasification: Gasifiers – Fixedbed system –Downdraft and updraft gasifiers –Fluidized bed gasifiers – Design, construction and operation Concepts of Gasifier Arrangements, Burner and Engine arrangements for electric power generation.

UNIT 3: (~8 Lecture Hours)

Biomass Combustion: Biomass stoves – Improved challahs, 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: (~8 Lecture Hours)

Biogas: Properties of biogas (Calorific value and composition), 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: (~7 Lecture Hours)

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

NOTE: A classroom activity such as Group Discussion involving all students to be conducted on the topics given in the second half of first unit.

Text Books:

1. Desai, Ashok V.," Non-Conventional Energy" Wiley Eastern Ltd.,1990.
2. Challal, D.S., "Food, Feed and Fuel from Biomass" IBH Publishing Co.Pvt.Ltd.,1991.
3. Nicholas P.Cheremisinoff, "Hand book of Solid Waste Management and Waste Minimization Technologies" An Imprint of Elsevier, New Delhi, 2003.
4. T.V. Ramachandra, Management of Municipal Solid Waste, The Energy and Resources Institute, TERI, 2009.

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 Land filling practice." Narosa Publishing House, New Delhi, 1999.
3. Khandelwal, K.C. and Mahdi S.S. "Biogas Technology-A Practical Hand Book Vol.I& II," Tata Mc Graw Hill Publishing Co.Ltd.' 1983.

Online Resouce:

1. https://nptel.ac.in/courses/103107125

Course Outcomes:

After completion of the course the student should be able to

CO1 Understand the methods of recycling of waste.
CO2 Compare the methods of waste disposal.
CO3 Identify different sources of energy from waste.
CO4 Analyze methods for management of waste.
CO5 Understand the global trade in hazardous waste.
CO6 Understand and adapt Waste minimization techniques as a societal responsibility.

❄ ❄ ❄

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

Course Code: **3 0 0 3**

POWER FROM RENEWABLE ENERGY SOURCES

(Open Elective)

Pre-requisite:

Course Objectives:

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

UNIT1:(~10LectureHours)

Fundamentals of Solar Energy-Solar spectrum- Solar Radiation on Earth's surface-Solar radiation geometry-Solar radiation measurements- Solar radiation data- Solarradiation on horizontal and tilted surfaces. Solar Thermal conversion- Flat platecollectors-concentratedcollectors-constructionandthermalanalysis-Solar applications-Solar ponds-Heliostat systems-waterheater-airheater-solarstill

UNIT2:(~8LectureHours)

Solar-ElectricPowergeneration-Photovoltaiccells-Equivalentcircuit-V-ICharacteristics-Photovoltaicmodules–constructionaldetails-designconsiderations- Tracking- Maximum power point tracking - Solar Thermo electricconversion.

UNIT3:(~8LectureHours)

WindEnergy-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

UNIT4:(~9LectureHours)

EnergyfromBioMass-Variousfuels-Sources-Conversiontechnologies-WetProcesses – 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-pressurere sources-Petro-thermal systems(HDR)-Magma Resources-PrimeMovers.

UNIT5:(~9LectureHours)

Ocean Thermal Energy ConversionS ystems-Principle of operation-Openand closed cycles, Energy from Tides - Principle of Tidal Power - Components of tidal Power plants-Operation Methods-Estimation of Energyin Single and doublebasin systems - Energy and Power from Waves Wave energy conversion devices -FuelCells-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.

TextBooks:

1. JohnTwidell & Wier, "Renewable Energy Resources",CRC Press, 2009.
2. G.D.Rai, "Non Conventional Energy sources",Khanna publishers, 2004.

ReferenceBooks:

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 Photo voltaics-Fundamentals-Principles and Applications",PHI,2009
4. S.P.Sukhatme,"Solar Energy Principles and Application",TMH,2009.

Online Resource: https://nptel.ac.in/courses/103103206

CourseOutcomes:

After completion of the course the student should be able to

CO1 Analyse solar thermal and photo voltaic systems and related technologies for energy conversion.

CO2 Understand Wind energy conversion and devices available for it.

CO3 Understand Biomass conversion technologies, Geothermal resources and energy conversion principles and technologies

CO4 Realize Power from oceans (thermal,wave,tidal) and conversion devices

CO5 Understand fundamentals of fuel cells and commercial batteries.

CO6 Suggest suitable methods of power generation for a particularregion/organization based on the availability of resources.

❄ ❄ ❄

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1:	Attainment of good theoretical base in basic courses, in-depth technical knowledge, hands-on experience and practical skills in Digital Electronics and Communication Engineering related areas.
PEO2:	Gaining ability to analyze and interpret the engineering problems in domain specific and inter-disciplinary fields, specifying the requirements, identifying the software tools enabling successful modeling/simulations, and carrying out successful design and development of mini systems and projects.
PEO3:	Acquirement of advanced level knowledge with enhanced confidence levels for necessary analyses and experiments in identified areas, and successfully applying them for research and developmental works, facilitating research paper publications and professional advancements.
PEO4:	Possession of comprehensive masters level proficiency in use of software tools and hardware design, enhancing interpretation, presentation skills and teaching abilities, meeting industry needs and societal requirements.
PEO5:	Inculcation of abilities for planning career progress in ascertained areas of technical interest, with determined focus on - teaching, research, industry orientation, or entrepreneurship fields, ensuring professional ethics and active network connectivity

PROGRAM OUTCOMES – M.Tech. (DECE)

PO1:	An ability to independently carry out research/investigation and development work to solve practical problems.
PO2:	An ability to write and present a substantial technical report/document.
PO3:	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
PO4:	Students will have the necessary theoretical base in depth, technical and professional skills to identify their compatibility levels and successfully plan for their career progress in Teaching/ R&D/ Industry Sectors, confirming perpetual learning and multi-disciplinary options.
PO5:	Ability to establish a good knowledge sharing network and peer connectivity through professional society memberships, conduct of seminars, technical events and creative workshops, and earn prominence, ensuring ethical base and societal trust.

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

INSTITUTE VISION

To become a center of quality education in Engineering and Technology for women empowerment.

INSTITUTE MISSION

- To fulfill the academic aspirations of women engineers for enhancing their intellectual capabilities and technical competency.
- To Leverage Leading – Edge Technologies and cultivate exemplary work culture.
- To facilitate success in their desired career in the field of engineering to build a progressive nation.

INSTITUTE QUALITY POLICY

G. Narayanamma Institute of Technology and Science (For Women), Hyderabad is committed in imparting Quality Education and Training for women empowerment in the field of "Engineering and Technology" and to satisfy applicable requirements through continual improvement of the Quality Management System by facilitating and supporting the staff and students to work as a team in upgrading their knowledge and skill in tune with the industrial and technological developments through a set of Quality objectives.