K.S.R.M.
COLLEGE OF ENGINEERING

(UGC - Autonomous)
Accredited by NAAC with A+ Grade & B.Tech. (EEE, ECE, CSE, CE and ME) Programs by NBA
An ISO 9001:2015, 14001: 2015 & 50001: 2018 Certified Institution

ACADEMIC REGULATIONS (R25PG)
COURSE STRUCTURE AND SYLLABI

(Effective for the students admitted into I year
from the academic year 2025 -2026 onwards)

MASTER OF TECHNOLOGY (M.Tech.)
EMBEDDED SYSTEM AND VLSI
(Regular, Full-time)

K.S.R.M. COLLEGE OF ENGINEERING

VISION:

To evolve as a centre of repute for providing quality academic programs amalgamated with creative learning and research excellence to produce graduates with leadership qualities, ethical and human values to serve the nation.

MISSION:

M1. Provide high quality education with enriched curriculum blended with impactful Teaching-Learning practices.

M2. Promote Research, Entrepreneurship and Innovation through industry collaborations.

M3. Produce highly competent professional leaders for contributing to socio-economic development of the region and the nation.

DEPARTMENT

OF

ELECTRONICS AND COMMUNICATION ENGINEERING

VISION

To emerge as globally recognized department in the frontier areas of Electronics and Communication Engineering.

MISSION

M1. To imbibe experiential, lifelong learning skills and problem-solving capabilities through enriched curriculum and innovative teaching learning practices.

M2. To promote quality research by strengthening industry collaborations.

M3. To inculcate entrepreneurial attitude, leadership skills, human values and professional ethics.

M.TECH. EMBEDDED SYSTEMS AND VLSI

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1. To equip postgraduates with advanced knowledge and analytical skills in Embedded systems and VLSI for solving complex engineering problems and conducting quality research.

PEO2. To enable postgraduates to contribute effectively in Embedded systems and Semiconductor manufacturing, research organizations, academia, and industries by applying appropriate tools and technologies.

PEO3. To foster innovation and promote lifelong learning in emerging areas of embedded systems, Internet of Things, IC design and Semiconductor manufacturing.

PEO4. To develop professional ethics, communication skills, and leadership qualities to work effectively in multidisciplinary teams and contribute to sustainable development.

PROGRAM OUTCOMES (POs)

After successful completion of the program, postgraduates will be able to

PO1. Apply advanced concepts of embedded systems and IC Design to analyze and solve complex engineering problems using modern tools and techniques.

PO2. Conduct research and investigations to address challenges in embedded systems, Internet of Things, Analog and Digital IC Design.

PO3. Design efficient and sustainable embedded system components and semiconductor manufacturing that meet performance, safety, and environmental requirements.

PO4. Use advanced software, simulation tools, and project management skills for analysing and executing embedded system and VLSI projects.

PO5. Communicate technical information effectively and uphold ethical standards in professional practice and decision-making.

PO6. Pursue lifelong learning and understand the social, environmental, and global impact of embedded systems and VLSI Technology solutions.

K.S.R.M. COLLEGE OF ENGINEERING

(AUTONOMOUS)

Academic Regulations of M.Tech. (Full Time/Regular) Programme

(Effective for the students admitted into I year from the Academic Year 2025-26 and onwards)

K.S.R.M. College of Engineering (KSRMCE) offers **Two** Years (**Four** Semesters) full-time Master of Technology (M.Tech.) Degree programme, under Choice Based Credit System (CBCS) in different branches of Engineering and Technology with different specializations.

The affiliating university Jawaharlal Nehru Technological University Anantapur shall confer M.Tech. degree on candidates who are admitted to the programme and fulfill all the requirements for the award of the degree.

1. Award of the M.Tech. Degree

A student will be declared eligible for the award of the M.Tech. degree if he/she fulfils the following:

1.1 Pursues a course of study for not less than two academic years and not more than four academic years.

1.2 Registers for 75 credits and secures all 75 credits.

2. Students, who fail to fulfil all the academic requirements for the award of the degree within four academic years from the year of their admission, shall forfeit their seat in M.Tech. course and their admission stands cancelled.

3. Programme of Study:

The following M.Tech. Specializations are offered at present in different branches of Engineering and Technology and are as follows:

Discipline	**Name of the Specialization**	**Code**
Civil Engineering	Geo Technical Engineering	12
Electrical and Electronics Engineering	Power Systems	52
Mechanical Engineering	Renewable Energy	99
Computer Science and Engineering	Artificial Intelligence and Data Science	98
Electronics & Communication Engineering	Embedded Systems & VLSI	84

4. Eligibility for Admissions:

4.1 Admission to the M. Tech Program shall be made subject to the eligibility, qualification and specialization prescribed by the A.P. State Government/University from time to time.

4.2 Admissions shall be made either on the basis of either the merit rank or Percentile obtained by the qualified student in the relevant qualifying GATE Examination/ the merit rank obtained by the qualified student in an entrance test conducted by A.P. State Government (APPGECET) for M.Tech. programmes an entrance test conducted by University/on the basis of any other exams approved by the University, subject to reservations as laid down by the Govt. from time to time.

5. Programme related terms:

5.1 ***Credit:*** A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (Lecture/Tutorial) or two hours of practical work/field work per week.

Credit definition:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 credit

5.2 ***Academic Year:*** Two consecutive (one odd + one even) semesters constitute one academic year.

5.3 ***Choice Based Credit System (CBCS):*** The CBCS provides choice for students to select from the prescribed courses.

6. Programme Pattern:

6.1 Total duration of the of M.Tech. programme is two academic years

6.2 Each academic year of study is divided into two semesters.

6.3 Each Semester shall be of 22 weeks duration (inclusive of Examinations), with a minimum of 90 instructional days per semester.

6.4 The student shall not take more than four academic years to fulfill all the academic requirements for the award of M.Tech. degree from the date of commencement of first year first semester, failing which the student shall forfeit the seat in M.Tech. programme.

6.5 The medium of instruction of the programme (including examinations and project reports) will be in English only.

6.6 All subjects/courses offered for the M.Tech. degree programme are broadly classified as follows:

S. No.	Broad Course Classification	Course Category	Description
1.	Core Courses	Foundational & Professional Core Courses (PC)	Includes subjects related to the parent discipline / department / branch of Engineering/specialization.
2.	Elective Courses	Program Elective Courses (PE)	Includes elective courses related to the parent discipline / department / branch of Engineering
		Open Elective Courses (OE)	Elective courses which include inter-disciplinary courses or courses in an area outside the parent discipline which are of importance in the context of special skill development
3.	Mandatory Courses	Quantum Technology and Application	To understand importance of latest technologies, research and process of creation of patents through research
		Research methodology & IPR	
4.	Integrated Experiential Learning Courses	Skill Enhancement courses (SE)	Interdisciplinary / job-oriented / domain courses which are relevant to the industry
		Comprehensive Viva	To test the overall domain knowledge
		Short Term Industry Internship	To provide real time exposure
		Dissertation	To provide application of domain knowledge to solve real problems

S. No.	Broad Course Classification	Course Category	Description
5.	Audit Courses	Mandatory non-credit courses	Covering courses of developing desired attitude among the learners.

6.7 The college shall take measures to implement Virtual Labs (https://www.vlab.co.in) which provide remote access to labs in various disciplines of Engineering and will help student in learning basic and advanced concept through remote experimentation. Student shall be made to work on virtual lab experiments during the regular labs.

6.8 A faculty advisor/mentor shall be assigned to each specialization to advise students on the programme, its Course Structure and Curriculum, Choice of Courses, based on his competence, progress, pre-requisites and interest.

6.9 Preferably 25% course work for the theory courses in every semester shall be conducted in the blended mode of learning.

7. Attendance Requirements:

7.1 A student shall be eligible to appear for the Semester-End examinations if he/she acquires i) a minimum of 50% attendance in each course and ii) 75% of attendance in aggregate of all the courses.

7.2 Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee.

7.3 Condonation of shortage of attendance shall be granted only on genuine and valid reasons on representation by the candidate with supporting evidence

7.4 Students whose shortage of attendance is not condoned in any semester are not eligible to take their semester-end examination of that class.

7.5 A stipulated fee shall be payable towards condonation of shortage of attendance.

7.6 A student will not be promoted to the next semester unless he satisfies the attendance requirements of the present semester. They may seek re-admission into that semester when offered next.

7.7 If any candidate fulfils the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

7.8 If the learning is carried out in blended mode (both offline & online), then the total attendance of the student shall be calculated considering the offline and online attendance of the student.

8. Evaluation – Distribution and Weightage of Marks:

The performance of a student in each semester shall be evaluated course - wise (irrespective of credits assigned), for a maximum of 100 marks for theory and 100 marks for practical, based on Internal Evaluation and Semester-End Examination.

8.1 There shall be five units in each of the theory courses. For the theory courses 60 marks will be for the Semester-End Examination and 40 marks will be for Internal Evaluation.

8.2 Two Internal Examinations shall be conducted for 30 marks each, one in the middle of the Semester and the other immediately after the completion of instruction period. The other 10 marks is awarded for continuous assessment in the form of assignments, quizzes, open book examination, presentation, etc. First mid examination shall be conducted for I & II units of the syllabus and second mid examination for III, IV & V units. Each mid

exam shall be conducted for a total duration of 120 minutes with 3 questions (without choice) and each question carries 10 marks. Final Internal marks for a total of 40 marks shall be arrived at by considering the marks secured by the student in both the internal examinations with 80% weightage to the better internal exam and 20% to the other.

8.3 The following pattern shall be followed in the End Examination:

i. Five questions shall be set from each of the five units with either/or type for 12 marks each.
ii. All the questions have to be answered compulsorily.
iii. Each question may consist of one, two or more sub-questions.

8.4 For practical courses, 60 marks shall be for the Semester-End Examinations and 40 marks will be for internal evaluation based on the day-to-day performance.

The internal evaluation based on the day-to-day work-10 marks, record- 10 marks and the remaining 20 marks to be awarded by conducting an internal laboratory test. The semester-end examination shall be conducted by the examiners, with a breakup mark of Procedure-10, Experimentation-25, Results-10, Viva-Voce-15.

8.5 There shall be Mandatory **Audit courses** in I & II semesters for zero credits. There is no external examination for audit courses. However, attendance shall be considered while calculating aggregate attendance and student shall be declared to have passed the mandatory course only when he/she secures 50% or more in the internal examinations. In case, the student fails, a re-examination shall be conducted for failed candidates for 40 marks for every six months/semester satisfying the conditions mentioned in item 1 & 2 of the regulations.

8.6 A candidate shall be deemed to have secured the minimum academic requirement in a course if he secures a minimum of 40% of marks in the Semester-End Examination and a minimum aggregate of 50% of the total marks in the Semester-End Examination and Internal Evaluation taken together.

8.7 In case the candidate does not secure the minimum academic requirement in any of the courses he/she has to reappear for the Semester-End Examination either supplementary or regular in that course or repeat the course when next offered or do any other specified course as may be required.

8.8 The laboratory records and mid semester test papers shall be preserved for a minimum of 3 years in the respective institutions as per the University norms and shall be produced to the Committees of the University as and when the same are asked for.

9. Credit Transfer Policy

As per University Grants Commission (Credit Framework for Online Learning Courses through SWAYAM) Regulation, 2016, students are allowed to do up to a maximum of 40% of the Professional and Open Electives in a semester through SWAYAM/SWAYAM Plus.

9.1 The college offers credit mobility for MOOCs and give the equivalent credit weightage to the students for the credits earned through online learning courses through SWAYAM platform.

9.2 The online learning courses available on the SWAYAM platform will be considered for credit transfer. SWAYAM course credits are as specified in the platform

9.3 Student registration for the MOOCs shall be only through the college, it is mandatory for the student to share necessary information with the college

9.4 The institution will list out the courses to be permitted for credit transfer through

SWAYAM. However, while selecting courses in the online platform institution would essentially avoid the courses offered through the curriculum in the offline mode.

9.5 The institution will notify at the beginning of semester the list of the online learning courses eligible for credit transfer in the forthcoming Semester.

9.6 Students may register for an 8-week (2 credits) or 12-week (3 credits) SWAYAM / SWAYAM plus course with the approval of the Head of the Department (HoD).

9.7 Examination fees, if applicable, shall be borne by the student. Pass marks and grading will be as per the JNTUA academic regulations.

9.8 A student must get minimum 40% marks for assignments and quizzes on the SWAYAM/ SWAYAM plus platform to be eligible for the semester-end examination. The students who are unable to get minimum internal marks in SWAYAM/ SWAYAM plus platform, they have to re-register for the course in subsequent semester through SWAYAM/ SWAYAM plus platform.

9.9 The semester-end exam may be conducted by the National Testing Agency (NTA), the National Programme on Technology Enhanced Learning (NPTEL) or the College during the regular term-end exams. Evaluation shall comprise 60% weightage for the semester-end examination and 40% for assignments and quizzes conducted by the SWAYAM/ SWAYAM plus course coordinator. The student has to get 50% marks for internal and external with minimum of 40% marks in the external examination to declare them as pass.

9.10 The institution also ensures that the student completes the course and produces the course completion certificate as per the academic schedule given for the regular courses in that semester. However, the credits will be transferred to the students who got minimum 50% marks with 40% marks in the external examination

9.11 The institution will designate a faculty member as a Mentor for each course to guide the students from registration till completion of the credit course.

9.12 The college will ensure no overlap of SWAYAM MOOC exams with that of the semester-end examination schedule. In case of delay in SWAYAM results, the college will re-issue the marks sheet for such students.

9.13 Student pursuing courses under MOOCs shall acquire the required credits only after successful completion of the course and submitting a certificate issued by the competent authority along with the minimum 50% of marks and grades.

9.14 The institution maintains the following in the examination section and submits as and when demanded by the university:

a) List of students who have passed MOOC courses in the current semester along with the certificates of completion.
b) Undertaking form filled by the students for credit transfer.

9.15 The college will resolve any issues that may arise in the implementation of this policy from time to time and shall review its credit transfer policy in the light of periodic changes brought by UGC, SWAYAM, NPTEL and state government.

Note: Students are also be permitted to register for MOOCs offered through online platforms other than SWAYAM NPTEL. In such cases, credit transfer shall be permitted only after seeking approval of the Principal with the recommendations of the concerned HoD and Dean, Academics at least three months prior to the commencement of the semester.

10. Re-registration for Improvement of Internal Evaluation Marks:

A candidate shall be given one chance to re-register for each course provided the internal marks secured by a candidate are less than 50% and has failed in the end examination

10.1 The candidate should have completed the course work and obtained examinations results for **I, II and III** semesters.

10.2 The candidate should have passed all the courses for which the Internal Evaluation marks secured are more than 50%.

10.3 Out of the courses the candidate has failed in the examination due to Internal Evaluation marks secured being less than 50%, the candidate shall be given one chance for each Theory course and for a maximum of **three** Theory courses for Improvement of Internal evaluation marks.

10.4 The candidate has to re-register for the chosen courses and fulfill the academic requirements.

10.5 For re-registration, the candidates have to apply to the Principal through the respective HoD by paying the requisite fees and get approval from the Principal before the start of the semester in which re-registration is required

10.6 In the event of availing the Improvement of Internal evaluation marks, the internal evaluation marks as well as the Semester-End Examinations marks secured in the previous attempt(s) for the reregistered courses stand cancelled.

11. Evaluation of Project/Dissertation Work:

The Project work shall be initiated at the beginning of the III-Semester and the duration of the Project is of two semesters. Evaluation of Project work is for 300 marks with 200 marks for internal evaluation and 100 marks for external evaluation. Progress of the project work is monitored through three reviews:

- Project review – I at the beginning of the III semester for zero marks
- Project review – II at the end of the third semester for 100 marks
- Project review – III before submission of the thesis i.e., end of the IV semesters for 100 marks

External evaluation of final Project work viva voce in IV semester shall be for 100 marks.

A Project Review Committee (PRC) shall be constituted with the Head of the Department as Chairperson, Project Supervisor and one faculty member of the department offering the M.Tech. programme.

11.1 A candidate is permitted to register for the Project Work in III Semester after satisfying the attendance requirements in all the courses, both theory and laboratory (in I & II semesters).

11.2 A candidate is permitted to submit Project dissertation with the approval of PRC. The candidate has to pass all the theory, practical and other courses before submission of the Thesis.

11.3 Project work shall be carried out under the supervision of teacher in the parent department concerned.

11.4 A candidate shall be permitted to work on the project in an industry/research organization on the recommendation of the Head of the Department. In such cases, one

of the teachers from the department concerned would be the internal guide and an expert from the industry/research organization concerned shall act as co-supervisor/external guide. It is mandatory for the candidate to make full disclosure of all data/results on which they wish to base their dissertation. They cannot claim confidentiality simply because it would come into conflict with the Industry's or R&D laboratory's own interests. A certificate from the external supervisor is to be included in the dissertation.

11.5 Continuous assessment of Project Work - I and Project Work – II in III & IV semesters respectively will be monitored by the PRC.

11.6 The candidate shall submit status report by giving seminars in three different phases (two in III semester and one in IV semester) during the project work period. These seminar reports must be approved by the PRC before submission of the Project Thesis.

11.7 After registration, a candidate must present in Project Review - I, in consultation with his Project Supervisor, the title, objective and plan of action of his Project work to the PRC for approval within four weeks from the commencement of III Semester. Student shall initiate the project work, only after obtaining the approval of the PRC.

11.8 The Project Review - II in III semester carries internal marks of 100. Evaluation should be done by the PRC for 50 marks and the Supervisor will evaluate the work for the other 50 marks. The Supervisor and PRC will examine the Problem Definition, Objectives, Scope of Work, Literature Survey in the same domain and progress of the Project Work.

11.9 A candidate has to secure a minimum of 50% of marks to be declared successful in Project Review - II. Only after successful completion of Project Review – II, candidate shall be permitted for Project Work Review – III in IV Semester. The unsuccessful students in Project Review - II shall reappear after three months.

11.10 The Project Review - III in IV semester carries 100 internal marks. Evaluation should be done by the PRC for 50 marks and the Supervisor will evaluate it for the other 50 marks. The PRC will examine the overall progress of the Project Work and decide whether or not eligible for final submission. A candidate has to secure a minimum of 50% of marks to be declared successful in Project Review - III. If student fails to obtain the required minimum marks, he/she has to reappear for Project Review - III after a month.

11.11 For the approval of PRC, the candidate shall submit the draft copy of dissertation to the Head of the Department and make an oral presentation before the PRC.

11.12 After approval from the PRC, the student is permitted to submit a report. The dissertation report will be accepted only when the plagiarism is within 30% checked through Turnitin software (repository mode). The plagiarism report shall be submitted along with the dissertation report.

11.13 Research paper related to the Project Work shall be published in an SCI / SCIE / ESCI / Scopus or in conference proceedings with ISBN number organized by professional societies such as IEEE, IEI, etc.

11.14 After successful plagiarism check and publication of research paper, three copies of the dissertation certified by the supervisor and HOD shall be submitted to the College.

11.15 The dissertation shall be adjudicated by an external examiner selected by the College. For this, a panel of three examiners shall be submitted by the supervisor concerned and department head for each student. However, the dissertation will be adjudicated by one examiner nominated by the Principal.

11.16 If the report of the examiner is not satisfactory, the candidate shall revise and resubmit the dissertation, in the time frame as decided by the PRC. If report of the examiner is unfavorable again, the thesis shall be summarily rejected. The candidate has to reregister for the project and complete the project within the stipulated time after taking the approval from the Principal.

11.17 If the report of the examiner is satisfactory, the Head of the Department shall coordinate and make arrangements for the conduct of Project Viva voce exam.

11.18 The Project Viva voce examinations shall be conducted by a board consisting of the Supervisor, Head of the Department and the external examiner who has adjudicated the dissertation. For Dissertation Evaluation (Viva voce) in IV Sem. there are external marks of 100 and it is evaluated by external examiner. The candidate has to secure a minimum of 50% marks in Viva voce exam.

11.19 If he fails to fulfill the requirements as specified, he will reappear for the Project Viva voce examination only after three months. In the reappeared examination also, if he fails to fulfill the requirements, he will not be eligible for the award of the degree.

12 Industry Internships:

Industry internship either onsite or virtual with a minimum of 06-08 weeks duration, done at the end of 1st year second semester. It shall be completed in collaboration with local industries, Govt. Organizations, construction agencies, Power projects, software MNCs or any industries in the areas of concerned specialization of the PG program. The student shall register for the internship as per course structure after commencement of academic year.

Evaluation of the summer internships shall be through the departmental committee. A student will be required to submit a summer internship report to the concerned department and appear for an oral presentation before the departmental committee comprising of Head of the Department, Mentor/Supervisor of the internship and a senior faculty member of the department. A certificate of successful completion from industry shall be included in the report. Internship will be evaluated for 100 marks with 50 marks for the report evaluated by the mentor and 50 marks for oral presentation. A student should secure minimum 50% of marks for successful completion. In case, if a student fails, he/she shall reappear as and when semester supplementary examinations are conducted by the College.

13 Comprehensive Viva

A Comprehensive Viva shall be conducted after the II Semester examinations for 100 marks by a committee consisting of the Head of the Department, one senior faculty member of the same specialization, and an external subject expert appointed by the Principal. The student must secure a minimum of 50% marks to be declared as passed

14 Credits for Co-curricular Activities

A Student should earn 01 credits under the head of co-curricular activities, viz., attending Conference, Scientific Presentations and Other Scholarly Activities. The guidelines for awarding Credits for Co-curricular Activities are detailed in the following Table.

Name of the Activity	Maximum Credits / Activity
Participation in National Level Seminar / Conference / Workshop / Training programs (related to the specialization of the student)	0.5
Participation in International Level Seminar / Conference / Workshop / Training programs held outside India (related to the specialization of the student)	1
Academic Award/Research Award from State Level / National Agencies	0.5
Academic Award / Research Award from International Agencies	1
Research / Review Publication in National Journals (Indexed in Scopus / Web of Science)	0.5
Research / Review Publication in International Journals with Editorial board outside India (Indexed in Scopus / Web of Science)	1

Note:

i) Credit shall be awarded only for the first author. Certificate of attendance and participation in a Conference/Seminar is to be submitted for awarding credit. A minimum participation of five days is required to earn the necessary credits. Alternatively, the student may attend five different one day programs to meet this requirement.

ii) Certificate of attendance and participation in workshops and training programs (Internal or External) is to be submitted for awarding credit. The total duration should be at least one week.

iii) Participation in any activity shall be permitted only once for acquiring required credits under cocurricular activities

15 Grading:

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

After each course is evaluated for 100 marks, the marks obtained in each course will be converted to a corresponding letter grade as given below, depending on the range in which the marks obtained by the student fall.

Structure of Grading of Academic Performance

Range in which the marks in the course fall	Grade	Grade points Assigned
≥ 90	S (Superior)	10
≥ 80 < 90	A (Excellent)	9
≥ 70 < 80	B (Very Good)	8
≥ 60 < 70	C (Good)	7
≥ 50 < 60	D (Pass)	6
< 50	F (Fail)	0
Absent	Ab (Absent)	0

i) A student obtaining Grade "F" or Grade "Ab" in a course shall be considered failed and will be required to reappear for that course when it is offered the next supplementary examination.

ii) For noncredit audit courses, "Satisfactory" or "Unsatisfactory" shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA / CGPA / Percentage.

Computation of Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

The Semester Grade Point Average (SGPA) is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.,

$SGPA = \Sigma (C_i \times G_i)/\Sigma C_i$

where, C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course.

i) The Cumulative Grade Point Average (CGPA) will be computed in the same manner considering all the courses undergone by a student over all the semesters of a program, i.e.,
   $CGPA = \Sigma (C_j \times S_i)/ \Sigma C_j$
   where "S_i" is the SGPA of the i^{th} semester and C_j is the total number of credits up to that semester.
ii) Both SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.
iii) While computing the SGPA the courses in which the student is awarded Zero grade points will also be included.

Grade Point: It is a numerical weight allotted to each letter grade on a 10-point scale. Letter Grade: It is an index of the performance of students in a said course. Grades are denoted by letters S, A, B, C, D and F.

16 Award of Class:

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree, he shall be placed in one of the following three classes:

Class Awarded	CGPA to be secured
First Class with Distinction	≥7.5%
First Class	< 7.5≥ 6.5
Pass Class	< 6.5

17 Exit Policy:

The student shall be permitted to exit with a PG Diploma based on his/her request to the university through the respective institution at the end of first year subject to passing all the courses in first year.

The Academic Council shall resolve any issues that may arise in the implementation of this policy from time to time and shall review the policy in the light of periodic changes brought by UGC, AICTE and State government.

18 Withholding of Results:

If the candidate has any case of in-discipline pending against him/her, the result of the candidate shall be withheld, and he/she will not be allowed/promoted into the next higher semester. The issue of degree is liable to be withheld in such cases.

19 Transitory Regulations

Discontinued, detained, or failed candidates are eligible for readmission as and when the semester is offered after fulfilment of academic regulations. Candidates who have been detained for want of attendance or not fulfilled academic requirements or who have failed after having undergone the course in earlier regulations or have discontinued and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent courses as and when courses are offered, subject to Section 2 and they will follow the academic regulations into which they are readmitted.

20 General:

20.1 The academic regulations should be read as a whole for purpose of any interpretation.

20.2 Disciplinary action for Malpractice / improper conduct in examinations is appended.

20.3 There shall be no places transfer within the constituent colleges and affiliated colleges of Jawaharlal Nehru Technological University Anantapur.

20.4 Where the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

20.5 In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.

20.6 The College may change or amend the academic regulations or syllabi at any time and the changes or amendments shall be made applicable to all the students on rolls with effect from the dates notified by the College.

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RULES FOR

DISCIPLINARY ACTION FOR MALPRACTICES / IMPROPER CONDUCT IN EXAMINATIONS

S.No.	Nature of Malpractices / Improper conduct	Punishment
	If the candidate:	
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 course of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the course of the examination).	Expulsion from the examination hall and cancellation of the performance in that course only.
1.(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate 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 course only of all the candidates 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 course of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the courses of that semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the University.
3	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred for four consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the courses of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining courses of that semester/year. The candidate is also debarred for four consecutive semesters from class work and all University examinations if his

S.No.	Nature of Malpractices / Improper conduct	Punishment
	If the candidate:	
		involvement is established. Otherwise, the candidate is debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate 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 course only.
6.	Refuses to obey the orders of the Chief Superintendent /Assistant - Superintendent /any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that course and all other courses the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the courses of that semester / year. If the candidate physically assaults the invigilator / officer-in-charge of the Examinations, then the candidate is also debarred and forfeits his/her seat. In case of outsiders, they will be handed over to the police and a police case is registered against them.

S.No.	Nature of Malpractices / Improper conduct	Punishment
	If the candidate:	
	of the examination.	
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 course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate 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 course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate 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 course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester / year. The candidate is also debarred and forfeits the seat. Person (s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses 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 course only or in that course and all other courses the candidate has appeared including practical examinations and project work of that semester / year

S.No.	Nature of Malpractices / Improper conduct	Punishment
	If the candidate:	
		examinations, depending on the recommendation of the committee.
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.	

1. Malpractices identified by squad or special invigilators
2. Punishments to the candidates as per the above guidelines.
3. Punishment for institutions: (if the squad reports that the college is also involved in encouraging malpractices)
4. A show cause notice shall be issued to the college.
5. Impose a suitable fine on the college.
6. Shifting the examination center from the college to another college for a specific period of not less than one year.

Note:

Whenever the performance of a student is cancelled in any course/courses due to Malpractice, he has to register for End Examinations in that course/courses consequently and has to fulfil all the norms required for the award of Degree.

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COURSE STRUCTURE
M.Tech. EMBEDDED SYSTEMS AND VLSI
I-SEMESTER

S. No.	Course Code	Course Title	Category	Hours per week			Credits
				L	T	P	
1.	2584101	CMOS Digital IC Design	PC	3	0	0	3
2.	2584102	Microcontrollers and Programmable Digital Signal Processors	PC	3	0	0	3
3.	**Program Elective-I**		PE	3	0	0	3
	2584103	Communication Buses and Interfaces					
	2584104	Data Acquisition System Design					
	2584105	FPGA Architectures and Applications					
4.	**Program Elective-II**		PE	3	0	0	3
	2584106	Low Power VLSI Design					
	2584107	Scripting Languages for VLSI					
	2584108	Network Security and Cryptography					
5.	2584151	CMOS Digital IC Design Lab	PC	0	0	4	2
6.	2584152	Microcontrollers and Programmable Digital Signal Processors Lab	PC	0	0	4	2
7.	2584153	IoT and RTOS for Embedded Applications	SE	0	1	2	2
8.	2599171	Research Methodology and Intellectual Property Rights	MC	2	0	0	2
9.	**Audit Course–I**		AC	2	0	0	0
	2599181	English for Research Paper Writing					
	2512181	Disaster Management					
	2598181	Essence of Indian Traditional Knowledge					
			TOTAL	**16**	**1**	**10**	**20**

II-SEMESTER

S. No.	Course Code	Course Title	Category	Hours per week			Credits
				L	T	P	
1.	2584201	CMOS Analog IC Design	PC	3	0	0	3
2.	2584202	Embedded Systems Design	PC	3	0	0	3
3.	**Program Elective-III**		PE	3	0	0	3
	2584203	Pattern Recognition and Machine Learning					
	2584204	Programming Languages for Embedded Software					
	2584205	RF IC Design					
4.	**Program Elective-IV**		PE	3	0	0	3
	2584206	SoC Architecture					
	2584207	System Design with Embedded Linux					
	2584208	Physical Design Automation					
5.	2584251	CMOS Analog IC Design Lab	PC	0	0	4	2
6.	2584252	Embedded Systems Design Lab	PC	0	0	4	2
7.	2584253	Comprehensive Viva Voce	PC	0	0	0	2
8.	2598281	Quantum Technologies and Applications	MC	2	0	0	2
9.	**Audit Course–II**		AC	2	0	0	0
	25HS201	Pedagogy Studies					
	25HS202	Personality Development through Life Enlightenment Skills					
	25HS203	Yoga for Stress Management					
			TOTAL	**16**	**0**	**8**	**20**

* Students have to undergo an Industry Internship during Summer break in II-Semester for 06 to 08 weeks duration.

III-SEMESTER

S. No.	Course Code	Course Title	Category	Hours per week			Credits
				L	T	P	
1.	**Program Elective-V**		PE	3	0	0	3
	2584301	Adhoc and Wireless Sensor Networks					
	2584302	VLSI Signal Processing					
	2584303	Industrial Internet of Things					
2.	2584351	Dissertation Phase – I	PR	0	0	20	10
3.	2584352	Industry Internship	PC	0	0	0	2
4.	2584353	Co-curricular Activities	MC	0	0	0	1
5.		Open Elective	OE	3	0	0	3
			TOTAL	**6**	**0**	**20**	**19**

Open Elective

S.No.	Course Code	Course Name	Offered by Dept.
1	2512381	Green Buildings	Civil
2	2512382	Road Safety Engineering	
3	2598381	Advanced Data Structures & Algorithms	CSE
4	2598382	Cloud Computing	
5	2598383	AI Tools	
6	2584381	IoT and its Applications	ECE
7	2552381	Photovoltaic Systems	EEE
8	2599381	Integrated Product Design and Development	ME
9	25HS381	Advanced Numerical Methods and Computational Mathematics	Mathematics
10	25HS382	Mathematics for Machine Learning and Data Science	
11	25HS383	Statistical Learning Theory and Mathematical Foundations of AI	
12	25HS384	Chemistry of Nanomaterials and Applications in Engineering	Chemistry
13	25HS385	Photonics For Engineers	Physics

IV-SEMESTER

S. No.	Course Code	Course Title	Category	Hours per week			Credits
				L	T	P	
1.	2584451	Dissertation Phase-II	PR	0	0	32	16
			TOTAL	**0**	**0**	**32**	**16**

2584101	M.Tech., I-SEMESTER CMOS DIGITAL IC DESIGN (EMBEDDED SYSTEMS AND VLSI)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Demonstrate advanced knowledge in Static and dynamic characteristics of CMOS,

CO2. Estimate Delay and Power of Adders circuits.

CO3. Classify different semiconductor memories.

CO4. Analyze, design and implement combinational and sequential MOS logic circuits.

CO5. Analyze complex engineering problems critically in the domain of digital IC design for conducting research.

SYLLABUS:

UNIT–I:MOS DESIGN PSEUDO NMOS LOGIC (09 Periods)

Inverter, Inverter threshold voltage, Output high voltage, Output Low voltage, Gain at gate threshold voltage, Transient response, Rise time, Fall time, Pseudo NMOS logic gates, Transistor equivalency, CMOS Inverter logic.

UNIT-II: COMBINATIONAL MOS LOGIC CIRCUITS (09 Periods)

MOS logic circuits with NMOS loads, Primitive CMOS logic gates–NOR & NAND gate, Complex Logic circuits design–Realizing Boolean expressions using NMOS gates and CMOS gates, AOI and OIA gates, CMOS full adder, CMOS transmission gates, Designing with Transmission gates.

UNIT-III: SEQUENTIAL MOS LOGIC CIRCUITS (08 Periods)

Behavior of bi-stable elements, SR Latch, Clocked latch and flip flop circuits, CMOS D latch and edge triggered flip-flop

UNIT-IV: DYNAMIC LOGIC CIRCUITS (09 Periods)

Basic principle, Voltage Bootstrapping, Synchronous dynamic pass transistor circuits, Dynamic CMOS transmission gate logic, High performance Dynamic CMOS circuits.

UNIT-V:SEMICONDUCTOR MEMORIES (10 Periods)

Types, RAM array organization, DRAM – Types, Operation, Leakage currents in DRAM cell and refresh operation, SRAM operation Leakage currents in SRAM cells, Flash Memory-NOR flash and NAND flash.

Total Periods: 45

Text Books:

T1. Neil Weste, David Harris, "CMOS VLSI Design: A Circuits and Systems Perspective", 4th Edition, Pearson, 2010

T2. Digital Integrated Circuit Design – Ken Martin, Oxford University Press, 2011.

T3. CMOS Digital Integrated Circuits Analysis and Design – Sung-Mo Kang, Yusuf Leblebici, TMH, 3rd Edition, 2011.

Reference Books:

R1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press, 2011

R2. Digital Integrated Circuits – A Design Perspective, Jan M.Rabaey, Anantha Chandrakasan, Borivoje Nikolic, 2ndEdition, PHI.

2584102	M.Tech., I-SEMESTER MICROCONTROLLERS AND PROGRAMMABLE DIGITAL SIGNAL PROCESSORS (EMBEDDED SYSTEMS AND VLSI)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

CO1. Explain ARM Cortex-Mx architecture, registers, instruction sets, memory system, and pipeline.

CO2. Analyze exceptions, interrupts, NVIC configuration, SysTick, and interrupt latency.

CO3. Apply LPC17xx peripherals (GPIO, timers, ADC, UART, PWM, RTC, WDT) for embedded applications.

CO4. Differentiate P-DSP architectural features (Harvard, MAC, barrel shifter, multi-port memory).

CO5. Demonstrate VLIW/TMS320C6000 architecture and write assembly programs using addressing modes.

SYLLABUS:

UNIT–I: ARM CORTEX-MX PROCESSOR (09 Periods)

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

UNIT-II: EXCEPTIONS AND INTERRUPTS IN ARM CORTEX-MX PROCESSORS (09 Periods)

Exceptions, Types, Priority, Vector Tables, Interrupt Inputs and Pending behaviour, Fault Exceptions, Supervisor and Pendable Service Call, Nested Vectored Interrupt Controller, Basic Configuration, SYSTICK Timer, Interrupt Sequences, Exits, Tail Chaining, Interrupt Latency.

UNIT-III: LPC 17XX MICROCONTROLLER (09 Periods)

LPC 17xx microcontroller- Internal memory, GPIOs, Timers, ADC, UART and other serial interfaces, PWM, RTC, WDT.

UNIT-IV: PROGRAMMABLE DSP (P-DSP) PROCESSORS (09 Periods)

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

UNIT-V: VLIW ARCHITECTURE AND TMS320C6000 SERIES (09 Periods)

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.

Total Periods: 45

Textbooks:

T1. Joseph Yiu, “The definitive guide to ARM Cortex-M3”, Elsevier, 2nd Edition

T2. Venkatramani B. and Bhaskar M. “Digital Signal Processors: Architecture, Programming and Applications”, TMH, 2nd Edition.

Reference Books:

R1. Sloss Andrew N, Symes Dominic, Wright Chris, “ARM System Developer's Guide: Designing and Optimizing”, Morgan Kaufman Publication.

R2. Steve furber, “ARM System-on-Chip Architecture”, Pearson Education

R3. Frank Vahid and Tony Givargis, “Embedded System Design”, Wiley

R4. Technical references and user manuals on www.arm.com, NXP Semiconductor,www.nxp.com and Texas Instruments www.ti.com

2584103	M.Tech., I-SEMESTER COMMUNICATION BUSES AND INTERFACES (EMBEDDED SYSTEMS AND VLSI) (PROFESSIONAL ELECTIVE-I)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Differentiate various serial bus standards (RS232, RS485, I2C, SPI) with respect to features, limitations, and applications.

CO2. Analyze CAN bus architecture, layers, frame formats, and applications.

CO3. Explain PCIe configuration, protocols, and applications.

CO4. Interpret USB transfer types, descriptors, and device enumeration process.

CO5. Evaluate Serial FPDP configurations, frames, and transmission techniques.

SYLLABUS:

UNIT-I: SERIAL BUSES **(09 Periods)**

Cables, Serial buses, serial versus parallel, Data and Control Signal- data frame, data rate, features, Limitations and applications of RS232, RS485, I2C, SPI

UNIT-II: CAN ARCHITECTURE **(09 Periods)**

ISO 11898-2, ISO 11898-3, Data Transmission- ID allocation, Bit timing, Layers- Application layers, Object layer, Transfer layer, Physical layer, Frame formats- Data frame, Remote frame, Error frame, Overload frame, Ack slot, Interframe spacing, Bit spacing, Applications.

UNIT-III: PCIe **(09 Periods)**

Revision, Configuration space- configuration mechanism, Standardized registers, Bus enumeration, Hardware and Software implementation, Hardware protocols, Applications.

UNIT-IV: USB **(09 Periods)**

Transfer Types- Control transfers, Bulk transfer, Interrupt transfer, Isochronous transfer. Enumeration- Device detection, Default state, Addressed state, Configured state, enumeration sequencing. Descriptor types and contents- Device descriptor, configuration descriptor, Interface descriptor, Endpoint descriptor, String descriptor. Device driver.

UNIT-V: DATA STREAMING SERIAL COMMUNICATION PROTOCOL **(09 Periods)**

Serial Front Panel Data Port (SFPDP) configurations, Flow control, serial FPDP transmission frames, fiber frames and copper cable.

Total Periods: 45

Textbooks:

T1. A Comprehensive Guide to controller Area Network – Wilfried Voss, Copperhill Media Corporation, 2nd Ed., 2005.

T2. Serial Port Complete-COM Ports, USB Virtual Com Portsand Ports for Embedded Systems-Jan Axelson, Lakeview Research, 2nd Ed.,

Reference Books:

R1. USB Complete – Jan Axelson, Penram Publications.

R2. PCI Express Technology – Mike Jackson, Ravi Budruk, Mindshare Press.

2584104	M.Tech., I-SEMESTER DATA ACQUISITION SYSTEM DESIGN (EMBEDDED SYSTEMS AND VLSI) (PROFESSIONAL ELECTIVE-I)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Explain the fundamentals of data acquisition systems.
CO2. Analyze different configurations of data acquisition systems.
CO3. Demonstrate knowledge of DAQ hardware components
CO4. Compare and contrast various communication buses and interfaces
CO5. Design and develop data acquisition systems by integrating hardware and software.

SYLLABUS:

UNIT-I: INTRODUCTION TO DAQ AND SIGNAL CONDITIONING (09 Periods)

Fundamentals of Data Acquisition Systems, Sensors and Transducers, Signal conditioning - Introduction, Types of signal conditioning, Classes of signal conditioning, DAQ Hardware, DAQ Software, Communications Cabling, Parameters of a DAQ System.

UNIT-II: DAQ SYSTEM CONFIGURATIONS AND I/O INTERFACES (09 Periods)

Data acquisition system configuration, Computer plug in I/O, Distributed I/O, Stand-alone or distributed loggers/controllers- Introduction, Methods of operation, Stand-alone logger/controller hardware, firmware & software design, Communications hardware interface, Host software, Considerations, internal systems, USB overall structure, PCMCIA card

UNIT-III: DATA ACQUISITION SYSTEMS (09 Periods)

Hardware-Introduction, Plug-in DAQ Systems, Converters A/D, Converters D/A, Amplifier, Multiplexer/De-multiplexer, Power Management, Timing System, Filtering, Memory Board, Bus Interface.

UNIT-IV: DAQ COMMUNICATION TECHNOLOGIES AND STANDARDS (08 Periods)

Communication Bus-Bus and FireWire, Serial Communications, Wireless, Ethernet and Bluetooth, GSM for Data Acquisition System, PCI and PCI Express, Standard VME.

UNIT-V: DESIGN OF DATA ACQUISITION SYSTEM (10 Periods)

Introduction to the Design, Functional Design of high-Speed Computers-Based DAS, Portable DAS, Design Guidelines for High-PerformanceMultichannel. Software for Data Acquisition Systems, Introduction to LabVIEW, Android forDAQ, Design of Firmware, Example of Implementation of a Software.

Total Periods: 45

Textbooks:

T1. Maurizio Di Paolo Emilio “Data acquisition systems-from fundamentals to applied design” springer, 013.
T2. John Park and Steve Mackay “Practical Data acquisition for instrumentation and control systems” Elsevier, 2003.

Reference Books:

R1. Robert H King, “Introduction to Data Acquisition with LabVIEW”, 2nd edition, 2012, McGraw

2584105	M.Tech., I-SEMESTER FPGA ARCHITECTURES AND APPLICATIONS (EMBEDDED SYSTEMS AND VLSI) (PROFESSIONAL ELECTIVE-I)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Acquire knowledge about various architectures and device technologies of PLD's.

CO2. Comprehend FPGA Architectures.

CO3. Analyze System level Design and their application for Combinational and Sequential Circuits.

CO4. Familiarize with Anti-Fuse Programmed FPGAs.

CO5. Apply knowledge of this subject for various design applications.

SYLLABUS:

UNIT-I: INTRODUCTION TO PROGRAMMABLE LOGIC DEVICES (09 Periods)

Introduction, Simple Programmable Logic Devices – Read Only Memories, Programmable Logic Arrays, Programmable Array Logic, Programmable Logic Devices/Generic Array Logic; Complex Programmable Logic Devices–Architecture of Xilinx Cool Runner XCR3064XL CPLD, CPLD Implementation of a Parallel Adder with Accumulation.

UNIT-II: FIELD PROGRAMMABLE GATE ARRAYS (10 Periods)

Field Programmable Gate Arrays: Organization of FPGAs, FPGA Programming Technologies, Programmable Logic Block Architectures, Programmable Interconnects, and Programmable I/O blocks in FPGAs, Dedicated Specialized Components of FPGAs, and Applications of FPGAs.

UNIT-III: SRAM PROGRAMMABLE FPGAs (08 Periods)

Introduction, Programming Technology, Device Architecture, the Xilinx XC2000, XC3000 and XC4000 Architectures.

UNIT-IV: ANTI-FUSE PROGRAMMED FPGAs (09 Periods)

Introduction, Programming Technology, Device Architecture, The Actel ACT1, ACT2 and ACT3 Architectures.

UNIT–V: DESIGN APPLICATIONS (09 Periods)

General Design Issues, Counter Examples, A Fast Video Controller, A Position Tracker for a Robot Manipulator, A Fast DMA Controller, Designing Counters with ACT devices, Designing Adders and Accumulators with the ACT Architecture

Total Periods: 45

Textbooks:

T1. Field Programmable Gate Array Technology - Stephen M. Trim Berger, Springer International Edition.

T2. Digital Systems Design - Charles H. Roth Jr, Lizy Kurian John, Cengage Learning.

Reference Books:

R1. Field Programmable Gate Arrays-John V.Oldfield, Richard C.Dorf, Wiley India.

R2. Digital Design Using Field Programmable Gate Arrays - Pak K. Chan/SamihaMourad, Pearson Low Price Edition.

R3. Digital Systems Design with FPGAs and CPLDs-Ian Grout, Elsevier,Newnes.

R4. FPGA based System Design-Wayne Wolf, Prentice Hall Modern Semiconductor Design Series.

2584106	M.Tech., I-SEMESTER LOW POWER VLSI DESIGN (EMBEDDED SYSTEMS AND VLSI) (PROFESSIONAL ELECTIVE-II)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Understand the need for low-power circuit design and analyze various sources of power dissipation.

CO2. Apply different low-power design methodologies to reduce power consumption.

CO3. Design and compare low-voltage, low-power adder architectures using various CMOS logic styles and evaluate their performance.

CO4. Analyze and implement low-power multiplier architectures for efficient arithmetic operations.

CO5. Describe and evaluate low-voltage, low-power memory design techniques.

SYLLABUS:

UNIT-I: FUNDAMENTALS (10 Periods)

Need for Low Power Circuit Design, Sources of Power Dissipation – Static and Dynamic Power Dissipation, Short Circuit Power Dissipation, Glitching Power Dissipation, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

UNIT-II: LOW-POWER DESIGN APPROACHES (09 Periods)

Low-Power Design through Voltage Scaling – VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches. Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, Mask level Measures.

UNIT-III: LOW-VOLTAGE LOW-POWER ADDERS (09 Periods)

Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look Ahead Adders, Carry Select Adders, Carry Save Adders, Low-Voltage Low-Power Design Techniques – Trends of Technology and Power Supply Voltage, Low-Voltage Low-Power Logic Styles.

UNIT-IV: LOW-VOLTAGE LOW-POWER MULTIPLIERS (08 Periods)

Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.

UNIT-V: LOW-VOLTAGE LOW-POWER MEMORIES: (09 Periods)

Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Pre-charge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

Total Periods: 45

Textbooks:

T1. CMOS Digital Integrated Circuits – Analysis and Design, Sung-Mo Kang, Yusuf Leblebici, TMH, 2011

T2. Low-Voltage, Low-Power VLSI Subsystems – Kiat-Seng Yeo, Kaushik Roy, TMH Professional Engineering.

Reference Books:

R1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press, 2011.

R2. Low Power CMOS Design – Anantha Chandrakasan, IEEE Press/Wiley International, 1998.

R3. Low Power CMOS VLSI Circuit Design – Kaushik Roy, Sharat C. Prasad, John Wiley & Sons, 2000.

2584107	M.Tech., I-SEMESTER SCRIPTING LANGUAGES FOR VLSI (EMBEDDED SYSTEMS AND VLSI) (PROFESSIONAL ELECTIVE-II)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Gain fluency in programming with scripting languages

CO2. Create and run scripts using PERL/TCL/PYTHON in CAD Tools

CO3. Create and run scripts using advanced PERL/TCL

CO4. Demonstrate the use of PERL/PYTHON/ TCL in developing system and web applications

CO5. Develop a real time project using PERL/PYTHON

SYLLABUS:

UNIT-I: INTRODUCTION TO SCRIPTS AND SCRIPTING (09 Periods)

Basics of Linux, Origin of Scripting languages, scripting today, Characteristics and uses of scripting languages.

UNIT-II: PERL (08 Periods)

Introduction to PERL, Names and values, Variables and assignment, Scalar expressions, Control structures, Built-in functions, Collections of Data, Working with arrays, Lists and hashes, Simple input and output, Strings, Patterns and regular expressions, Subroutines, Scripts with arguments.

UNIT-III: ADVANCED PERL (09 Periods)

Finer points of Looping, Subroutines, Using Pack and Unpack, working with files, Type globs, Eval, References, Data structures, Packages, Libraries and modules, Objects and modules in action, tied variables, interfacing to the operating systems, Security issues.

UNIT-IV: TCL (09 Periods)

The TCL phenomena, Philosophy, Structure, Syntax, Parser, Variables and data in TCL, Control flow, Data structures, Simple input/output, Procedures, Working with Strings, Patterns, Files and Pipes, Example code.

UNIT-V: ADVANCED TCL (10 Periods)

The eval, source, exec and up-level commands, Libraries and packages, Namespaces, trapping errors, Event-driven programs, Making applications 'Internet-aware', 'Nuts-and-bolts' internet programming, Security issues, TCL and TK integration.

PYTHON: Introduction to PYTHON language, PYTHON-syntax, statements, functions, Built-in functions and Methods, Modules in PYTHON, Exception Handling.

Total Periods: 45

Textbooks:

T1. The World of Scripting Languages- David Barron, Wiley Student Edition.

T2. PYTHON Web Programming, Steve Holden and David Beazley, New Riders Publications

Reference Books:

R1. TCL/TK: A Developer's Guide- ClifFlynt, Morgan Kaufmann Series.

R2. Core PYTHON Programming, Chun, Pearson Education.

R3. Learning Perl, Randal L. Schwartz, O' Reilly publications 6th edition.

R4. Linux: The Complete Reference", Richard Peterson McGraw Hill Publications, 6th Edition.

2584108	M.Tech., I-SEMESTER NETWORK SECURITY AND CRYPTOGRAPHY (EMBEDDED SYSTEMS AND VLSI) (PROFESSIONAL ELECTIVE-II)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Explain the need for Security, identify different attacks, and apply Classical encryption techniques with basic Cryptanalysis.

CO2. Apply number theory concepts such as modular arithmetic, theorems, and algorithms in solving Cryptographic Problems.

CO3. Demonstrate symmetric Encryption Algorithms and Analyze their Resistance to Cryptanalysis.

CO4. Apply Public-Key Cryptographic techniques, hash functions, and message authentication codes for secure Communication.

CO5. Evaluate authentication Protocol, Intrusion detection methods and system- level security mechanisms for protecting networks.

SYLLABUS:

UNIT-I: SECURITY **(09 Periods)**

Need, security services, Attacks, OSI Security Architecture, one-time passwords, Model for Network security, Classical Encryption Techniques like substitution ciphers, Transposition ciphers, Cryptanalysis of Classical Encryption Techniques.

UNIT-II: NUMBER THEORY **(08 Periods)**

Introduction, Fermat's and Euler's Theorem, The Chinese Remainder Theorem, Euclidean Algorithm, Extended Euclidean Algorithm, and Modular Arithmetic.

UNIT-III: PRIVATE-KEY (SYMMETRIC) CRYPTOGRAPHY **(09 Periods)**

Block Ciphers, Stream Ciphers, RC4 Stream cipher, Data Encryption Standard (DES), Advanced Encryption Standard (AES), Triple DES, RC5, IDEA, Linear and Differential Cryptanalysis.

UNIT-IV: PUBLIC-KEY (ASYMMETRIC) CRYPTOGRAPHY **(09 Periods)**

RSA, Key Distribution and Management, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography, Message Authentication Code, hash functions, message digest algorithms: MD4 MD5, Secure Hash algorithm, RIPEMD-160, HMAC.

UNIT-V: AUTHENTICATION AND SYSTEM SECURITY **(10 Periods)**

IP and Web Security Digital Signatures, Digital Signature Standards, Authentication Protocols, Kerberos, IP security Architecture, Encapsulating Security Payload, Key Management, Web Security Considerations, Secure Socket Layer, Secure Electronic Transaction Intruders, Intrusion Detection, Password Management, Worms, viruses, Trojans, Virus Countermeasures, Firewalls, Trusted Systems.

Total Periods: 45

Textbooks:

T1. William Stallings, "Cryptography and Network Security, Principles and Practices", Pearson Education, 3rd Edition.

T2. Charlie Kaufman, Radia Perlman and Mike Speciner, “Network Security, Private Communication in a Public World”, Prentice Hall, 2ND Edition.

Reference Books:

R1. Christopher M. King, Ertem Osmanoglu, Curtis Dalton, “Security Architecture, Design Deployment and Operations”, RSA Pres,
R2. Stephen Northcutt, LenyZeltser, Scott Winters, Karen Kent, and Ronald W. Ritchey, “Inside Network Perimeter Security”, Pearson Education, 2ndEdition
R3. Richard Bejtlich, “The Practice of Network Security Monitoring: Understanding IncidentDetection and Response”, William Pollock Publisher, 2013.

2584151	M.Tech., I-SEMESTER CMOS DIGITAL IC DESIGN LAB (EMBEDDED SYSTEMS AND VLSI)	L	T	P	C
		0	0	4	2

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Explain the VLSI Design Methodologies using any VLSI design tool.

CO2. Grasp the significance of various design logic Circuits in full-custom IC Design.

CO3. Explain the Physical Verification in Layout Extraction.

CO4. Fully appreciate the design and analyze of CMOS Digital Circuits.

CO5. Grasp the Significance of Pre-Layout Simulation and Post-Layout Simulation.

CO6. Apply appropriate tools and techniques to understand and analyze the problems following professional ethics with focus on societal and environmental aspects.

CO7. Communicate results in an effective way.

CO8. Make decisions to manage tasks and also engage in independent and life-long learning with ability to adapt to new and technological changes.

SYLLABUS:

The students are required to design and implement the Circuit and Layout using CMOS Technology.

1. Inverter Characteristics.
2. NAND and NOR Gate
3. XOR and XNOR Gate
4. 2:1 Multiplexer
5. Full Adder
6. RS-Latch
7. Clock Divider
8. JK-Flip Flop
9. Synchronous Counter
10. Asynchronous Counter
11. Static RAM Cell
12. Dynamic Logic Circuits
13. Linear Feedback Shift Register

Lab Requirements:

Software:

Mentor Graphics Tool/ Cadence/ Synopsys/Industry Equivalent Standard Software

Hardware:

Personal Computer with necessary peripherals, configuration and operating System.

2584152	M.Tech., I-SEMESTER MICROCONTROLLERS AND PROGRAMMABLE DIGITAL SIGNAL PROCESSORS LAB (EMBEDDED SYSTEMS AND VLSI)	L	T	P	C
		0	0	4	2

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Install, configure and utilize tool sets for developing applications based on ARM processor.

CO2. Design and developtheARM7 based embedded systems for various applications.

CO3. Develop application programs on ARM and DSP development boards both in assembly and C.

CO4. Design and implement the digital filters on DSP6713 processor.

CO5. Analyze the hardware and software interaction and integration.

CO6. Apply appropriate tools and techniques to understand and analyze the problems following professional ethics with focus on societal and environmental aspects.

CO7. Communicate results in an effective way.

CO8. Make decisions to manage tasks and also engage in independent and life-long learning with ability to adapt to new and technological changes.

SYLLABUS:

Any 12 experiments need to be done, Minimum 02 from Part B

Part A

Experiments to be carried out on Cortex-Mx development boards and using GNU tool- chain

1. Blink an LED with software delay, delay generated using the SysTick timer.
2. System clock real time alteration using the PLL modules.
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. Take analog readings on rotation of rotary potentiometer connected to an ADC channel.
7. Temperature indication on an RGB LED.
8. Mimic light intensity sensed by the light sensor by varying the blinking rate of an LED.
9. 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. Sample sound using a microphone and display sound levels on LEDs.

Part B

Experiments to be carried out on DSP C6713 evaluation kits and using Code Composer Studio (CCS)

12. To develop an assembly code and C code to compute Euclidian distance between any two Points
13. To develop assembly code and study the impact of parallel, serial and mixed execution
14. To develop assembly and C code for implementation of convolution operation
15. To design and implement filters in C to enhance the features of given input sequence/signa

Software Requirements:

Keil for ARM, Code Composer Studio

Hardware Requirements:
ARM Cortex Mx Development Boards, TI TMS C6713 evaluation kit.

2584153	M.Tech., I-SEMESTER IOT AND RTOS FOR EMBEDDED APPLICATIONS (EMBEDDED SYSTEMS AND VLSI)	L	T	P	C
		0	1	2	2

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Demonstrate interfacing of sensors and actuators with IoT devices.

CO2. Acquire and integrate sensor data with cloud platforms using IoT protocols.

CO3. Apply RTOS concepts for multitasking and task scheduling.

CO4. Implement inter-process communication techniques in RTOS.

CO5. Design and develop IoT applications using embedded systems and RTOS.

SYLLABUS:

Module 1: IoT HARDWARE & SENSORS (09 Periods)

Introduction to IoT and embedded devices, Raspberry Pi and Beagle Bone Black: Architecture, GPIO, SPI, I2C interfaces, Basics of interfacing digital and analog sensors/actuators, Interfacing LEDs, Buzzer, Push Button, IR, and LDR sensors.

Experiments:

1. Setup Raspberry Pi, install OS and necessary software, test basic connectivity.
2. Interface LED and Buzzer; write Python program to blink LED periodically.
3. Interface Push Button or IR/LDR sensor; program to control LED based on input.

Module 2: IoT DATA COLLECTION & CLOUD INTEGRATION (09 Periods)

Reading environmental sensors (temperature, humidity), IoT communication protocols: MQTT, HTTP, REST APIs, Cloud integration using Thingspeak, MQTT brokers.

Experiments:

1. Interface DHT11 sensor with Raspberry Pi; display temperature and humidity readings.
2. Upload sensor data to Thingspeak cloud and retrieve for visualization.
3. Publish and subscribe sensor data using MQTT on BeagleBone Black.

Module 3: REAL-TIME OPERATING SYSTEMS (RTOS) FUNDAMENTALS (09 Periods)

Differences between Traditional OS and RTOS, Hard vs. Soft real-time systems; timing constraints and task scheduling, and multitasking concepts, Scheduling algorithms.

Experiments:

1. Introduction to VxWorks RTOS: kernel, task assignment, and multitasking basics.
2. Timer programming in VxWorks.
3. Create tasks and implement Round Robin scheduling.

Module 4: INTER-PROCESS COMMUNICATION (IPC) IN RTOS (09 Periods)

Task synchronization and communication, Semaphores: Binary and Counting, Message queues and mailboxes, Mutexes and critical sections.

Experiments:

1. Task communication using message queues in VxWorks.

2. Synchronize tasks using semaphores.
3. Implement IPC using mailboxes for data exchange between tasks.

Module 5: IoT APPLICATION DESIGN (09 Periods)

Designing integrated IoT solutions combining sensors, actuators, cloud, and RTOS tasks

Experiments (Choose one):

1. Design a weather monitoring system with real-time cloud data upload.
2. Smart home automation: Control lights/fans based on sensor inputs.
3. IoT-based vending machine prototype using VxWorks and sensors.

Total Periods: 45

References:

R1. Internet of Things: A Hands-on Approach, ArshdeepBahga and Vijay Madisetti, Universities Press, 2015.

R2. Real-Time Systems, Jane W.S. Liu, Pearson Education, Asia, 2018.

R3. VxWorks Programmers Guide, Wind River Systems Inc., 2019.

R4. Real-Time Systems, C. M. Krishna and G. Shin, McGraw-Hill, 2015.

R5. Practical Python Programming for IoT: Build advanced IoT projects using Raspberry Pi, MQTT, RESTful APIs, WebSockets, and Python 3, 2020.

		L	T	P	C
2599171	**M.Tech., I-SEMESTER** **RESEARCH METHODOLOGYAND INTELLECTUAL PROPERTY RIGHTS** (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) (MANDATORY COURSE)	**2**	**0**	**0**	**2**

Pre-Requisites: NIL

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Demonstrate the research process, types and methods, use data correctly, follow ethical rules, and use proper citation styles.

CO2. Apply appropriate data collection methods, identify data types and sources, ensure quality, and follow ethical practices using suitable tools.

CO3. Apply multivariate analysis and experimental design to study cause-effect relationships, ensure measurement validity, and write structured research papers and proposals.

CO4. Demonstrate the concept, evolution, and types of Intellectual Property Rights (IPR), recognize global IPR practices and institutions like WIPO, WTO, and UNESCO, and identify key agreements, trade secrets, and biodiversity-related rights.

CO5. Demonstrate the concept, features, and benefits of patents; identify types of patent applications and the filing process; and explain the roles of patent agents, licensing, and patent regulations.

SYLLABUS:

UNIT–I: FUNDAMENTALS OF RESEARCH METHODOLOGY (05 Periods)

Overview of research process and design - Types of Research - Approaches to Research (Qualitative vs Quantitative) - Observation studies, Experiments and Surveys - Use of Secondary and exploratory data to answer the research question - Importance of Reasoning in Research and Research ethics - Documentation Styles (APA/IEEE etc.) - Plagiarism and its consequences.

UNIT-II: DATA COLLECTION AND SOURCES (05 Periods)

Importance of Data Collection - Types of Data - Data Collection Methods - Data Sources - primary, secondary and Big Data sources - Data Quality & Ethics - Tools and Technology for Data Collection.

UNIT-III: DATA ANALYSIS AND REPORTING (06 Periods)

Overview of Multivariate analysis - Experimental research, cause-effect relationship, and development of hypotheses- Measurement systems analysis, error propagation, and validity of experiments - Guidelines for writing abstracts, introductions, methodologies, results, and discussions - Writing Research Papers & proposals.

UNIT- IV: UNDERSTANDING INTELLECTUAL PROPERTY RIGHTS (07 Periods)

Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT–V: PATENTS **(07 Periods)**

Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification - Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents

Total Periods: 30

Textbooks:

T1. Research Methodology: An introduction for Science & Engineering students, Stuart Melville and Wayne Goddard, Juta and Company Ltd, 2004

T2. Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets, Catherine J. Holland, Entrepreneur Press, 2007.

References Books:

R1. Business Research Methods, Cooper Donald R, Schindler Pamela S and Sharma JK, Tata McGraw Hill Education, 2012, Eleventh Edition,

R2. Research Methodology: A Step-by-Step Guide for Beginners, David Hunt, Long Nguyen, Matthew Rodgers, Wiley, 2007.

R3. Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets, Deborah E. Bouchoux, Cengage, 2024, Sixth Edition,

R4. The Craft of Research, Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams, University of Chicago Press, 2024, Fifth Edition.

R5. Professional Programme Intellectual Property Rights, Law and practice, The Institute of Company Secretaries of India, Statutory body under an Act of parliament, September, 2013.

Web Resources:

1. Research Methodology and Data Analysis courses, Coursera / edX
2. Latest journals on research design and statistics, Springer Link & ScienceDirect
3. Free access to research papers Google Scholar
4. Open-access research methodology resources, NCBI Bookshelf
5. For fundamentals of hypothesis testing, regression, and ANOVA. Khan Academy (Statistics & Probability)

2599181	M.Tech., I-SEMESTER ENGLISH FOR RESEARCH PAPER WRITING (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) (AUDIT COURSE-I)	L	T	P	C
		2	0	0	0

Pre-Requisites: NIL

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Demonstrate proficiency in academic English by applying MAP principles, using clear, precise, and objective language, structuring coherent paragraphs, integrating references, and employing paraphrasing and appropriate tone in writing.

CO2. Exhibit critical reading skills to analyze academic texts, differentiate between article types, identify arguments and methodologies, evaluate findings, and make effective notes.

CO3. Apply advanced grammar and punctuation to construct clear, accurate, and complex sentences with proper voice, tense consistency, subject-verb agreement, and unambiguous references.

CO4. Revise and refine written work by editing for clarity, coherence, and grammar; proofread for accuracy; and apply effective strategies for professional correspondence and creative writing.

CO5. Demonstrate digital literacy by critically evaluating online content, using AI tools ethically in research writing, generating accurate citations, and practicing plagiarism-free writing with awareness of fair practices.

SYLLABUS:

UNIT-I: FUNDAMENTALS OF ACADEMIC ENGLISH (05 Periods)

Academic English - MAP (Message-Audience-Purpose) - Language Proficiency for Writing - Key Language Aspects - Clarity and Precision - Objectivity - Formal Tone - Integrating References - Word order - Sentences and Paragraphs - Link Words for Cohesion - Avoiding Redundancy / Repetition - Breaking up long sentences - Structuring Paragraphs - Paraphrasing Skills – Framing Title and Sub-headings

UNIT-II: READING SKILLS FOR RESEARCHERS (06 Periods)

Reading Academic Texts - Critical Reading Strategies - Skimming and Scanning - Primary Research Article vs. Review Article - Reading an Abstract - Analyzing Research Articles - Identifying Arguments - Classifying Methodologies - Evaluating Findings - Making Notes

UNIT-III: GRAMMAR REFINEMENT FOR RESEARCH WRITING (06 Periods)

Advanced Punctuation Usage - Grammar for Clarity - Complex Sentence Structures - Active-Passive Voice - Subject-Verb Agreement - Proper Use of Modifiers - Avoiding Ambiguous Pronoun References - Verb Tense Consistency - Conditional Sentences.

UNIT-IV: MASTERY IN REFINING WRITTEN CONTENT/EDITING SKILLS

(07 Periods)

Effective Revisions - Restructuring Paragraph - Editing vs Proofreading, Editing for Clarity and Coherence - Rectifying Sentence Structure Issues - Proofreading for Grammatical Precision – Spellings - Tips for Correspondence with Editors - Critical and Creative Phases of Writing.

UNIT-V: TECHNOLOGY AND LANGUAGE FOR RESEARCH (06 Periods)

Digital Literacy and Critical Evaluation of Online Content - Technology and Role of AI in Research Writing – Assistance in Generating Citations and References - Plagiarism and Ethical Considerations – Tools and Awareness – Fair Practices

Total Periods: 30

Textbooks:

T1. Academic Writing: A Handbook for International Students. Routledge, Bailey. S. London and New York: 2015.

T2. English for Writing Research Papers, Adrian Wallwork, Springer New York Dordrecht Heidelberg London, 2011.

Reference books:

R1. Writing for Academic Success, Craswell, G., Sage Publications, 2004.

R2. Writing With Power, Peter Elbow, E-book, Oxford University Press, 2007

R3. Writing Academic English, Oshima, A. & Hogue, A., Addison-Wesley, New York, 2005

R4. Academic Writing for Graduate Students: Essential Skills and Tasks, Swales, J. & C. Feak, Michigan University Press, 2012.

R5. Writing for Science, Goldbort R., Yale University Press (available on Google Books), 2006

R6. How to Write and Publish a Scientific Paper, Day R., Cambridge University Press, 2006

Web Resources:

1. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-ge04/
2. https://onlinecourses.swayam2.ac.in/ntr24_ed15/preview
3. "Writing in the Sciences" – Stanford University (MOOC on Coursera) https://www.coursera.org/learn/sciwrite
4. Academic Phrasebank – University of Manchester http://www.phrasebank.manchester.ac.uk
5. OWL (Online Writing Lab) – Purdue University, https://owl.purdue.edu *(Resources on APA/MLA formats, grammar, structure, paraphrasing)*
6. Zotero or Mendeley (Reference Management Tools) – Useful for managing citations and sources.

2512181	M.Tech., I-SEMESTER DISASTER MANAGEMENT (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) (AUDIT COURSE - I)	L	T	P	C
		2	0	0	0

Pre-Requisites: Nil

COURSE OUT COMES:

After completion of the course, student will be able to

CO1. Identify and map disaster-prone areas and understand the epidemiological consequences of disasters.

CO2. Define and distinguish between hazards and disasters, and explain their types, nature, and impacts.

CO3. Assess the economic, social, and ecological repercussions of major natural and man-made disasters.

CO4. Apply risk assessment methods and propose disaster risk reduction strategies at local, national, and global levels.

CO5. Demonstrate knowledge of disaster preparedness tools such as remote sensing, meteorological data, risk evaluation, and community awareness.

SYLLABUS:

UNIT–I: INTRODUCTION (06 Periods)

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-II: REPERCUSSIONS OF DISASTERS AND HAZARDS (06 Periods)

Economic Damage - Loss of Human and Animal Life - Destruction of Ecosystem - Natural Disasters - Earthquakes, Volcanism, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster - Nuclear Reactor Meltdown - Industrial Accidents - Oil Slick sand Spills - Outbreaks of Disease and Epidemics War and Conflicts

UNIT-III: DISASTER PREPAREDNESS AND MANAGEMENT (06 Periods)

Preparedness - Monitoring of Phenomena - Triggering a Disaster or Hazard - Evaluation of Risk-Application of Remote Sensing - Data from Meteorological and Other Agencies -Media Reports-Governmental and Community Preparedness

UNIT-IV: RISK ASSESSMENT (06 Periods)

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

UNIT-V: DISASTER MITIGATION (06 Periods)

Meaning, Concept and Strategies of Disaster Mitigation – Emerging Trendsin Mitigation - Structural Mitigation and Non- Structural Mitigation - Programs of Disaster Mitigation in India

Total Periods: 30

Textbooks:

T1. Disaster Management, Gupta, H. K, Universities Press, 2003
T2. Natural Hazards and Disaster Management, Singh, R. B., Rawat Publications, 2006.

Reference Books:

R1. Introduction to International Disaster Management, Coppola, D. P., Elsevier, 4th ed., 2020.
R2. Science and Technology in Disaster Risk Reduction in Asia, Shaw, R., & Izumi, T., Springer, 2022.
R3. Handbook of Hazards and Disaster Risk Reduction and Management, Wisner, B., Gaillard, J. C., & Kelman, I., Routledge, 2nd ed., 2021.
R4. Disaster Management in India: Policy, Issues and Perspectives, Saini, V. K., Sage India, 2021.
R5. Disaster by Choice: How Our Actions Turn Natural Hazards into Catastrophes, Kelman, I., Oxford University Press, 2022
R6. Disaster Mitigation: Experiences and Reflections, Sahni, P. & Dhameja, A., Prentice Hall of India, 2004.

Web Resources:

1. https://ndma.gov.in – official guidelines, reports, and policy frameworks.
2. https://www.undrr.org – Sendai Framework, global risk reduction strategies.
3. https://www.gdacs.org – real-time disaster alerts
4. https://www.undrr.org – Sendai Framework, global risk reduction strategies.

		L	T	P	C
2598181	**M.Tech., I-SEMESTER** **ESSENCE OF** **INDIAN TRADITIONAL KNOWLEDGE** (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) **(AUDIT COURSE - I)**	**2**	**0**	**0**	**0**

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Illustrate traditional knowledge, its nature, characteristics, and scope

CO2. Demonstrate the need for protecting traditional knowledge and its significance in the global economy

CO3. Explain the legal framework and policies related to traditional knowledge protection

CO4. Apply traditional knowledge in different sectors, such as engineering, medicine, agriculture, and biotechnology

CO5. Analyze the importance of traditional knowledge in various contexts, including its historical impact and social change, relationship between traditional knowledge and intellectual property rights, including patents and non-IPR mechanisms

SYLLABUS:

UNIT-I: INTRODUCTION TO TRADITIONAL KNOWLEDGE (06 Periods)

Definition, Nature and characteristics, scope and importance - Kinds of traditional knowledge - Physical and social contexts in which traditional knowledge develop - Historical impact of social change on traditional knowledge systems - Indigenous Knowledge (IK) – Characteristics - traditional knowledge vis-à-vis indigenous knowledge -Traditional knowledge Vs western knowledge, traditional knowledge vis-à-vis formal knowledge

UNIT-II: PROTECTION OF TRADITIONAL KNOWLEDGE (06 Periods)

Need for protecting traditional knowledge - Significance of TK Protection - Value of TK in global economy - Role of Government to harness TK.

UNIT-III: LEGAL FRAME WORK AND TRADITIONAL KNOWLEDGE (06 Periods)

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 - Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act) –
The Biological Diversity Act 2002 and Rules 2004 - the protection of traditional knowledge bill, 2016 Geographical Indicators Act 2003.

UNIT-IV: TRADITIONAL KNOWLEDGE AND INTELLECTUAL PROPERTY (06 Periods)

Systems of traditional knowledge protection - Legal concepts for the protection of traditional knowledge - Certain non-IPR mechanisms of traditional knowledge protection - Patents and traditional knowledge - Strategies to increase protection of traditional knowledge -Global legal FORA for increasing protection of Indian Traditional Knowledge.

UNIT-V: TRADITIONAL KNOWLEDGE IN DIFFERENT SECTORS (06 Periods)

Traditional knowledge and Engineering - Traditional medicine system - TK and Biotechnology - TK in Agriculture - Traditional societies depend on it for their food and healthcare needs - Importance of conservation and sustainable development of environment - Management of biodiversity, Food security of the country and protection of TK

Total Periods: 30

Textbooks:

T1. Introduction to Indian Knowledge System: Concepts and Applications, Mahadevan, B., Bhat Vinayak Rajat, and Nagendra Pavana R.N., PHI Learning Pvt. Ltd., Delhi, 2022 (1st Edition).
T2. Traditional Knowledge System and Technology in India, Basanta Kumar Mohanta and Vipin Kumar Singh, Pratibha Prakashan, 2012 (1st Edition).

Reference Books

R1. Pride of India: A Glimpse into India's Scientific Heritage, Samskrita Bharati, New Delhi 2006.
R2. On Astronomy in Ancient India, Kak, S.C. Indian Journal of History of Science, 22(3), 1987
R3. Indian Astronomy: A Source Book, Subbarayappa, B.V. and Sarma, K.V. Nehru Centre, Mumbai, 1985.
R4. History of Technology in India, Vol. I, Bag, A.K., Indian National Science Academy, New Delhi, 1997.
R5. Indian Architecture, Acarya, P.K. Munshiram Manoharlal Publishers, New Delhi, 1996.
R6. Public Administration in Ancient India, Banerjea, P. Macmillan, London, 1961.
R7. Indian Knowledge Systems Vol – I & II, Kapoor Kapil, Singh Avadhesh, Indian Institute of Advanced Study, Shimla, H.P., 2022

Web Resources:

1. https://www.youtube.com/watch?v=LZP1StpYEPM
2. http://nptel.ac.in/courses/12110600

2584201	M. Tech., II-SEMESTER CMOS ANALOG IC DESIGN (EMBEDDED SYSTEMS AND VLSI)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Demonstrate MOS device physics, short channel effects, and MOS device models to evaluate the performance of single-stage CMOS amplifiers.

CO2. Demonstrate the operation of differential amplifiers, current mirrors, and current steering circuits to determine their differential and common-mode performance characteristics.

CO3. Analyze the frequency response and noise performance of single-stage and differential CMOS amplifiers using small-signal models.

CO4. Evaluate feedback amplifier topologies and operational amplifier characteristics including gain, stability, slew rate, PSRR, and frequency compensation techniques.

CO5. Design a two-stage CMOS operational amplifier incorporating compensation techniques to meet specified performance parameters.

SYLLABUS:

UNIT-I: BASIC MOS DEVICE PHYSICS (09 Periods)

General Considerations, MOS I/V Characteristics, Second Order effects, MOS Device models and MOS Capacitor. Short Channel Effects and Device Models. Single Stage Amplifiers – Basic Concepts, Common Source Stage, Source Follower, Common Gate Stage, Cascode Stage.

UNIT-II: DIFFERENTIAL AMPLIFIERS (10 Periods)

Single Ended and Differential Operation, Basic Differential Pair, Common Mode Response, Differential Pair with MOS loads, Gilbert Cell. Passive and Active Current Mirrors– Basic Current Mirrors, Cascode Current Mirrors, Active Current Mirrors. Current Steering Circuit.

UNIT-III: **FREQUENCY RESPONSE OF AMPLIFIERS (07 Periods)**

General Considerations, Common Source Stage, Source Followers, Common Gate Stage, Cascode Stage, Differential Pair. Noise – Types of Noise, Representation of Noise in circuits, Noise in single stage amplifiers, Noise in Differential Pairs

UNIT-IV: FEEDBACK AMPLIFIERS (10 Periods)

General Considerations, Feedback Topologies, Effect of Loading. Operational Amplifiers – General considerations, One Stage Op Amps, Two Stage Op Amps, Gain Boosting, Common – Mode Feedback, Input Range limitations, Slew Rate, Power Supply Rejection, Noise in Op Amps, Stability and Frequency Compensation.

UNIT-V: OPERATIONAL AMPLIFIERS (09 Periods)

One Stage Op-Amp, Two Stage Op-Amp, Gain Boosting, Common Mode Feed-Back, Input Range Limitations, Slew Rate, PSRR. Compensation of Two Stage Op-Amp, Slewing in Two Stage Op-Amp, Compensation Techniques. Design Procedure for 2-Stage Op-Amp.

Total Periods: 45

Textbooks:

T1. B. Razavi, ―Design of Analog CMOS Integrated Circuits‖, 2ndEdition, McGraw Hill Edition2016.

T2. Paul. R. Gray& Robert G. Meyer, ―Analysis and Design of Analog Integrated Circuits‖, Wiley,

Reference Books

R1. T.C. Carusone, D.A. Johns & K. Martin, ―Analog Integrated Circuit Design‖, 2ndEdition, Wiley, 2012.
R2. P.E. Allen& D.R. Holberg, ―CMOS Analog Circuit Design‖, 3rd Edition, Oxford University Press, 2011.
R3. R. Jacob Baker, ―CMOS Circuit Design, Layout, and Simulation‖, 3rd Edition, Wiley, 2010.
R4. Adel S. Sedra, Kenneth C. Smith, Arun, ―Microelectronic Circuits‖, 6th Edition, Oxford University Press.

2584202	M. Tech., II-SEMESTER EMBEDDED SYSTEMS DESIGN (EMBEDDED SYSTEMS AND VLSI)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Explain the fundamentals, characteristics, and application areas of embedded systems.

CO2. Analyze and select appropriate hardware components and communication interfaces for embedded system design.

CO3. Develop embedded firmware incorporating essential supporting circuits and suitable programming approaches.

CO4. Apply RTOS concepts including task management and scheduling in embedded system development.

CO5. Implement task communication and synchronization techniques in RTOS-based embedded systems.

SYLLABUS:

UNIT-I: FUNDAMENTALS OF EMBEDDED SYSTEMS (09 Periods)

Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

UNIT-II: EMBEDDED SYSTEM ARCHITECTURE AND HARDWARE COMPONENTS (10 Periods)

Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces. DDR, Flash, NVRAM.

UNIT-III: **EMBEDDED FIRMWARE AND SUPPORTING HARDWARE (08 Periods)**

Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

UNIT-IV: RTOS-BASED EMBEDDED SYSTEM DESIGN (09 Periods)

RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

UNIT-V: TASK COMMUNICATION AND SYNCHRONIZATION IN EMBEDDED SYSTEMS (09 Periods)

Types, RAM array organization, DRAM – Types, Operation, Leakage currents in DRAM cell and refresh operation, SRAM operation Leakage currents in SRAM cells, Flash Memory-NOR flash and NAND flash.

Total Periods: 45

Textbooks:

T1. Introduction to Embedded Systems, Shibu K.V, Mc Graw Hill.

Reference Books

R1. Embedded Systems, Raj Kamal, TMH.
R2. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley.
R3. Embedded Systems, Lyla, Pearson, 2013.
R4. An Embedded Software Primer - David E. Simon, Pearson Education.

		L	T	P	C
2584203	**M. Tech., II-SEMESTER** **PATTERN RECOGNITION AND MACHINE LEARNING** (EMBEDDED SYSTEMS AND VLSI) **(PROFESSIONAL ELECTIVE-III)**	**3**	**0**	**0**	**3**

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Apply dimensionality reduction and sequential pattern classification techniques to analyze and design optimal and nonparametric pattern recognition systems.

CO2. Analyze linear, Bayesian, and probabilistic generative and discriminative models using maximum likelihood, regularization, and iterative optimization techniques for multiclass prediction and inference.

CO3. Apply kernel methods, Gaussian processes, and sparse kernel machines to design regression and classification models, and extend solutions to multiclass learning problems.

CO4. Analyze and construct probabilistic graphical models using Bayesian networks and Markov random fields, and perform inference and graph structure learning for real-world applications.

CO5. Apply mixture models and the Expectation–Maximization algorithm to perform clustering, regression, and classification tasks.

SYLLABUS:

UNIT-I: INTRODUCTION TO PATTERN RECOGNITION (09 Periods)

Mathematical Formulation and Basic Functional Equation, Reduction of Dimensionality, Experiments in Pattern Classification, Backward Procedure for Both Feature Ordering- and Pattern Classification, Suboptimal Sequential Pattern Recognition, Nonparametric Design of Sequential Pattern Classifiers, Analysis of Optimal Performance and a Multiclass Generalization.

UNIT-II: LINEAR MODELS (09 Periods)

Linear Basis Function Models-Maximum likelihood and least squares, Geometry of least squares , Sequential learning, Regularized least squares, Multiple outputs, The Bias-Variance Decomposition, Bayesian Linear Regression -Parameter distribution, Predictive, Equivalent, Bayesian Model Comparison, Probabilistic Generative Models-Continuous inputs , Maximum likelihood solution, Discrete features, Exponential family, Probabilistic Discriminative Models Fixed basis functions, Logistic regression, Iterative reweighted least squares, Multiclass logistic regression, Probit regression, Canonical link functions.

UNIT-III: KERNEL METHODS (09 Periods)

Constructing Kernels, Radial Basis Function Networks - Nadaraya-Watson model, Gaussian Processes -Linear regression revisited, Gaussian processes for regression, Learning the hyper parameters, Automatic relevance determination, Gaussian processes for classification, Laplace approximation, Connection to neural networks, Sparse Kernel Machines- Maximum Margin Classifiers, Overlapping class distributions, Relation to logistic regression, Multiclass SVMs, SVMs for regression, Computational learning theory, Relevance Vector Machines- RVM for regression, Analysis of sparsity, RVM for classification.

UNIT-IV: GRAPHICAL MODELS (09 Periods)

Bayesian Networks, Example: Polynomial regression, Generative models, Discrete variables, Linear-Gaussian models, Conditional Independence- Three example graphs, Desperation, Markov Random Fields -Conditional independence properties, Factorization properties, Illustration: Image de-noising, Relation to directed graphs, Inference in Graphical Models- Inference on a chain, Trees,

Factor graphs, The sum-product algorithm, The max-sum algorithm, Exact inference in general graphs, Loopy belief propagation, Learning the graph structure.

UNIT-V: MIXTURE MODELS **(09 Periods)**

Mixture Models and EM algorithm: K-means Clustering-Image segmentation and compression, Mixtures of Gaussians-Maximum likelihood, EM for Gaussian mixtures, An Alternative View of EM Gaussian mixtures revisited, Relation to K-means, Mixtures of Bernoulli distributions, EM for Bayesian linear regression, The EM Algorithm in General, Combining Models- Tree-based Models, Conditional Mixture Models- Mixtures of linear regression models, Mixtures of logistic models, Mixtures of experts

Total Periods: 45

Text Books:

T1. Sequential methods in Pattern Recognition and Machine Learning-K.S. Fu, Academic Press, volume no.52.
T2. Pattern Recognition and Machine Learning- C. Bishop-Springer, 2006.

Reference Books

R1. Pattern Classification- Richard o. Duda, Peter E. hart, David G. Stork, John Wiley& Sons, 2nd Ed., 2001.
R2. The elements of Statistical Learning- Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, Springer, 2nd Ed., 2009

2584204	M. Tech., II-SEMESTER PROGRAMMING LANGUAGES FOR EMBEDDED SOFTWARE (EMBEDDED SYSTEMS AND VLSI) (PROFESSIONAL ELECTIVE-III)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Apply embedded C programming concepts to develop optimized drivers and interrupt-based applications for embedded systems.

CO2. Analyze the differences between procedural and object-oriented programming paradigms and illustrate OOP features for embedded applications.

CO3. Develop C++ programs using classes, constructors, dynamic memory allocation, and I/O operations for embedded software design.

CO4. Implement advanced C++ features such as operator overloading, inheritance, and templates in embedded software development.

CO5. Explain concepts of exception handling using try–catch–throw and multiple exceptions, and demonstrate the fundamentals of scripting languages including PERL, CGI, VBScript, and JavaScript with knowledge of PERL operators, statements, pattern matching, data structures, modules, objects, threads, and compilation techniques.

SYLLABUS:

UNIT-I: EMBEDDED 'C' PROGRAMMING (09 Periods)

Bitwise operations, Dynamic memory allocation, OS services, linked stack and queue, Sparse matrices, Binary tree, Interrupt handling in C, Code optimization issues, Writing LCD drives, LED drivers, Drivers for serial port communication, Embedded Software Development Cycle and Methods (Waterfall, Agile).

UNIT-II: OBJECT ORIENTED PROGRAMMING (09 Periods)

Introduction to procedural, modular, object oriented and generic programming techniques, Limitations of procedural programming, objects, classes, data members, methods, data encapsulation, data Abstraction and information hiding, inheritance, polymorphism

UNIT-III: CPP PROGRAMMING (08 Periods)

'cin', 'cout', formatting and I/O manipulators, new and delete operators, Defining a class, data members and methods, 'this' pointer, constructors, destructors, friend function, dynamic memory allocation.

UNIT-IV: OVERLOADING AND INHERITANCE (09 Periods)

Need of operator overloading, overloading the assignment, overloading using friends, type conversions, single inheritance, base and derived classes, friend classes, types of inheritance, hybrid inheritance, multiple inheritance.

Templates: Function template and class template, member function templates and template arguments.

UNIT-V: EXCEPTION HANDLING (10 Periods)

Syntax for exception handling code: try-catch-throw, Multiple Exceptions.

Scripting Languages: Overview of Scripting Languages – PERL, CGI, VB Script, Java Script. PERL: Operators, Statements Pattern Matching etc. Data Structures, Modules, Objects, Tied Variables, Inter process Communication Threads, Compilation & Line Interfacing.

Total Periods: 45

Textbooks:

T1. Michael J. Pont, ―Embedded C‖, Pearson Education, 2nd Edition,2008
T2. Robert Sedgewick, ―Algorithms in C++‖, Addison Wesley Publishing Company, 1999.

Reference Books

R1. Randal L. Schwartz, ―Learning Perl‖, O'Reilly Publications, 6th Edition2011
R2. Michael Berman, ―Data structures via C++‖, Oxford University Press, 2002

2584205	M. Tech., II-SEMESTER RF IC DESIGN (EMBEDDED SYSTEMS AND VLSI) (PROFESSIONAL ELECTIVE-III)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Design RF tuned circuits by applying RF system principles.

CO2. Analyze RF system nonlinearity and time-variance by applying MOS device physics, transmission line theory, and reflection coefficient concepts.

CO3. Demonstrate design of High Frequency Amplifiers.

CO4. Demonstrate various types of Power Amplifiers.

CO5. Develop and implement PLL-based frequency synthesis systems.

SYLLABUS:

UNIT-I: RF TUNED CIRCUITS (09 Periods)

RF systems – Basic architectures, Maximum Power Transfer, Passive RLC Networks, Parallel RLC tank, Q, Series RLC networks, matching, Pi match, T match, Passive components in IC: Resistors, capacitors, Inductors, Transceiver Architectures.

UNIT-II: NONLINEARITY AND REFLECTION COEFFICIENT (09 Periods)

Nonlinearity and Time Variance of system, sensitivity and dynamic range, Review of MOS Device Physics, MOS device review, Distributed Systems, Transmission lines, reflection coefficient, the wave equation Lossy transmission lines Smith charts – plotting gamma, Noise in FET: Thermal noise, flicker noise review.

UNIT-III: **HIGH FREQUENCY AMPLIFIER DESIGN (09 Periods)**

Bandwidth estimation using open-circuit time constants, Bandwidth estimation using short-circuit time constants, Rise-time, delay and bandwidth, Zeros to enhance bandwidth, Shunt- series amplifiers, tuned amplifiers Cascaded amplifiers, Noise figure, Intrinsic MOS noise parameters, LNA Design, Power match versus noise match.

UNIT-IV: RF POWER AMPLIFIERS (09 Periods)

Multiplier based mixers, Sub sampling mixers & Mixer Design, RF Power Large signal performance Amplifiers, Class A, AB, B, C amplifiers, Class D, E, F amplifiers, RF Power amplifier design issues.

UNIT-V: PLL (09 Periods)

Voltage controlled oscillators, Resonators, Negative resistance oscillators, Phase locked loops, Linearized PLL models, Phase detectors, charge pumps, Loop filters, PLL design examples, Frequency synthesis and oscillator Frequency division, integer-N synthesis, Fractional frequency synthesis, Phase noise.

Total Periods: 45

Textbooks:

T1. Thomas H. Lee, “The Design of CMOS Radio-Frequency Integrated Circuits”, Cambridge University Press, 2004.

T2. Behzad Razavi, “RF Microelectronics”, Prentice Hall, 1997.

Reference Books

R1. Abidi, P.R. Gray, and R.G. Meyer, eds., “Integrated Circuits for Wireless Communications”, New York: IEEE Press, 1999.

R2. R. Ludwig and P. Bretchko, “RF Circuit Design, Theory and Applications”, Pearson, 2000.

2584206	M. Tech., II-SEMESTER SoC ARCHITECTURE (EMBEDDED SYSTEMS AND VLSI) (PROFESSIONAL ELECTIVE-IV)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Explain the basics related to SoC architecture and different approaches related to SoC Design.

CO2. Select an appropriate robust processor for SoC Design.

CO3. Select an appropriate memory for SoC Design.

CO4. Examine SoC interconnect architectures and standard bus systems.

CO5. Apply SoC design methodologies to real-world applications

SYLLABUS:

UNIT-I: INTRODUCTION TO THE SYSTEM APPROACH (08 Periods)

System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory & Addressing. System level interconnection, An approach for SOC Design, System Architecture and Complexity.

UNIT-II: PROCESSORS (09 Periods)

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

UNIT-III: **MEMORY DESIGN FOR SOC (09 Periods)**

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

UNIT-IV: INTERCONNECT, CUSTOMIZATION AND CONFIGURABILITY (09 Periods)

Interconnect 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, Reconfigurable Technologies, Mapping design onto Reconfigurable devices, Instance- Specific design, Customizable Soft Processor, Reconfiguration - overhead analysis and trade-off analysis on reconfigurable Parallelism.

UNIT-V: APPLICATION STUDIES / CASE STUDIES: (10 Periods)

SOC Design approach; AES-algorithms, Design and evaluation; Image compression–JPEG compression.

Total Periods: 45

Textbooks:

T1. Computer System Design System-on-Chip - Michael J. Flynn and Wayne Luk, Wiely India Pvt. Ltd.
T2. ARM System on Chip Architecture – Steve Furber, 2ndEdition, 2000, Addison Wesley Professional.

Reference Books

R1. Design of System on a Chip: Devices and Components – Ricardo Reis, 1st Ed., 2004, Springer
R2. Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology) – Jason Andrews – Newnes, BK and CDROM.
R3. System on Chip Verification – Methodologies and Techniques –Prakash Rashinkar, Peter Paterson and Leena Singh L, 2001, Kluwer Academic Publishers.

2584207	M. Tech., II-SEMESTER SYSTEM DESIGN WITH EMBEDDED LINUX (EMBEDDED SYSTEMS AND VLSI) (PROFESSIONAL ELECTIVE-IV)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Explain the basic concepts of Embedded Linux and its architecture.
CO2. Explain the Linux BSP for a hardware platform
CO3. Develop and debug the drivers in Embedded Linux
CO4. Build and analyze the Linux kernel and root file system with debugging techniques.
CO5. Analyze Linux operation on MMU-less systems using uClinux.

SYLLABUS:

UNIT-I: INTRODUCTION (11 Periods)

Need of Embedded Linux, Embedded Linux versus Desktop Linux, Embedded Linux Distributions Embedded Linux Architecture, Kernel Architecture: Hardware Abstraction Layer (HAL), Memory Manager, Scheduler, File System, IO Subsystem, Networking Subsystems, IPC; User Space, Linux Start-Up Sequence.

UNIT-II: BOARD SUPPORT PACKAGE (09 Periods)

Inserting BSP in Kernel Build Procedure, the Boot Loader Interface, Memory Map, Interrupt Management, the PCI Subsystem, Timers, UART, and Power Management. Embedded Storage: Flash Map, Memory Technology Device, MTD Architecture, Embedded File Systems.

UNIT-III: **EMBEDDED DRIVERS (09 Periods)**

Linux Serial Driver, Ethernet Driver, and I2C Subsystem on Linux, USB Gadgets, Watchdog Timer, and Kernel Modules. Porting Applications: Architectural Comparison, Application Porting Roadmap.

UNIT-IV: REAL-TIME LINUX (08 Periods)

Linux and Real-Time: Building and Debugging: Building the Kernel, Building the Root File System, Integrated Development Environment, Elementary Concepts of Debugging. Embedded Graphics: Graphics System, Introduction to Display Hardware.

UNIT-V: UCLINUX (08 Periods)

Linux on MMU - Less Systems, Program Load and Execution, Memory Management, File / Memory Mapping.

Total Periods: 45

Textbooks:

T1. Exploring Beagle Bone: Tools and Techniques for Building with Embedded Linux, Derek Molloy, Wiley, 1st Edition, 2014.
T2. Embedded Linux Primer: A Practical Real-World Approach, Christopher Hallinan, Prentice Hall, 2nd Edition, 2010.

Reference Books

R1. Embedded Linux System Design and Development, P Raghvan, Amol Lad, Sriram Neelakandan, Auerbach Publications, 2005.
R2. Building Linux Systems, Karim Yaghmour, O 'Reilly & Associates,2008

2584208	M. Tech., II-SEMESTER PHYSICAL DESIGN AUTOMATION (EMBEDDED SYSTEMS AND VLSI) (PROFESSIONAL ELECTIVE-IV)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Apply algorithms and system design concepts to develop and verify efficient VLSI systems using appropriate design management tools.

CO2. Apply compaction, placement and routing algorithms to optimize VLSI layout, partitioning, and wire length.

CO3. Apply floor planning concepts, shape functions, and routing algorithms to optimize VLSI layout design

CO4. Apply gate-level and switch-level modeling for efficient two-level logic design and simulation.

CO5. Apply hardware modeling and high-level synthesis techniques for optimized digital system design.

SYLLABUS:

UNIT-I: VLSI DESIGN AUTOMATION TOOLS (09 Periods)

Algorithms and system design, Structural and logic design, Transistor level design, Layout design, Verification methods, Design management tools

UNIT-II: LAYOUT (09 Periods)

Compaction, placement and routing, Design rules, symbolic layout, Applications of compaction. Formulation methods, Algorithms for constrained graph compaction, Circuit representation, Wire length estimation, Placement algorithms, Partitioning algorithms.

UNIT-III: **FLOOR PLANNING AND ROUTING (09 Periods)**

Linux Serial Driver, Ethernet Driver, and I2C Subsystem on Linux, USB Gadgets, Watchdog Timer, and Kernel Modules. Porting Applications: Architectural Comparison, Application Porting Roadmap.

UNIT-IV: SIMULATION AND LOGIC SYNTHESIS (09 Periods)

Gate level and switch level modeling and simulation, Introduction to combinational logic synthesis, ROBDD principles, implementation, construction and manipulation, two level logic synthesis.

UNIT-V: HIGH-LEVEL SYNTHESIS (09 Periods)

Hardware model for high level synthesis, internal representation of input algorithms, Allocation, assignment and scheduling, scheduling algorithms, Aspects of assignment, High level transformations

Total Periods: 45

Textbooks:

T1. S.H. Gerez, Algorithms for VLSI Design Automation, John Wiley, 1998.

T2. N.A. Sherwani, Algorithms for VLSI Physical Design Automation, (3/e), Kluwer,1999

Reference Books

R1. S.M. Sait, H. Youssef, VLSI Physical Design Automation, World scientific, 1999.

R2. M. Sarrafzadeh, Introduction to VLSI Physical Design, McGraw Hill (IE), 1996

2584251	M. Tech., II-SEMESTER CMOS ANALOG IC DESIGN LAB (EMBEDDED SYSTEMS AND VLSI)	L	T	P	C
		0	0	4	2

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Explain the VLSI Design Methodologies using VLSI design tool.

CO2. Grasp the significance of various CMOS analog Circuits in full-custom IC Design.

CO3. Explain the Physical Verification in Layout Extraction.

CO4. Fully appreciate the design and analyze of CMOS Digital Circuits.

CO5. Grasp the Significance of Pre-Layout Simulation and Post-Layout Simulation.

CO6. Apply appropriate tools and techniques to understand and analyze the problems following professional ethics with focus on societal and environmental aspects.

CO7. Communicate results in an effective way.

CO8. Make decisions to manage tasks and also engage in independent and life-long learning with ability to adapt to new and technological changes.

List of Experiments:

The students are required to design and simulate any **TEN** experiments using CMOS Technology.

1. MOS Device Characterization and parametric analysis
2. Common Source Amplifier
3. Common Source Amplifier with source degeneration
4. Cascode amplifier
5. Simple current mirror
6. Cascode current mirror.
7. Wilson current mirror.
8. Differential Amplifier
9. Two stage Operational Amplifier
10. Sample and Hold Circuit
11. Direct-conversion ADC
12. R-2R Ladder Type DAC
13. Common Drain Amplifier
14. Inverter Layout
15. NAND/NOR Layout

Lab Requirements:

Software:

Mentor Graphics Tool/ Cadence/ Synopsys/Industry Equivalent Standard Software

Hardware:

Personal Computer with necessary peripherals, configuration and operating System.

2584252	M. Tech., II-SEMESTER EMBEDDED SYSTEMS DESIGN LAB (EMBEDDED SYSTEMS AND VLSI)	L	T	P	C
		0	0	4	2

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Configure and deploy embedded platforms by installing operating systems, required packages, and enabling remote access/display services.

CO2. Develop and test embedded programs for GPIO interfacing, sensor integration, and real-time hardware control applications.

CO3. Design and implement embedded applications involving signal monitoring, threshold-based control, and peripheral interfacing (LCD, LEDs, sensors, wearable devices).

CO4. Develop network-enabled embedded systems by integrating Wi-Fi, web services, RSS feeds, and remote communication protocols.

CO5. Build and deploy complete embedded system solutions including server hosting, multimedia streaming, and wireless communication applications using Arduino/Raspberry Pi/BeagleBone platforms.

CO6. Apply appropriate tools and techniques to understand and analyze the problems following professional ethics with focus on societal and environmental aspects.

CO7. Communicate results in an effective way.

CO8. Make decisions to manage tasks and also engage in independent and life-long learning with ability to adapt to new and technological changes.

List of Experiments:

1. Functional Testing of Devices: Flashing the OS on to the device into a stable functional state by porting desktop environment with necessary packages.
2. Exporting Display on to other Systems: Making use of available laptop/desktop displays as a display for the device using SSH client & X11 display server.
3. GPIO Programming: Programming of available GPIO pins of the corresponding device using native programming language. Interfacing of I/O devices like LED/Switch etc., and testing the functionality.
4. Interfacing Chronos eZ430: Chronos device is a programmable Texas Instruments watch which can be used for multiple purposes like PPT control, Mouse operations etc., Exploit the features of the device by interfacing with devices.
5. ON/OFF Control Based On Light Intensity: Using the light sensors, monitor the surrounding light intensity & automatically turn ON/OFF the high intensity LED's by taking some pre-defined threshold light intensity value.
6. Battery Voltage Range Indicator: Monitor the voltage level of the battery and indicating the same using multiple LED's (for ex: for 3V battery and 3 LEDs, turn on 3 LED s for 2-3V, 2 LEDs for 1-2V, 1 LED for 0.1-1V & turn off all for 0V)
7. Dice Game Simulation: Instead of using the conventional dice, generate a random value similar to dice value and display the same using a 16X2 LCD. A possible extension could be to provide the user with option of selecting single or double dice game.
8. Displaying RSS News Feed on Display Interface: Displaying the RSS news feed headlines on a LCD display connected to device. This can be adapted to other websites like twitter or other information websites. Python can be used to acquire data from the internet.
9. Porting Open w.r.t the Device: Attempt to use the device while connecting to a Wi-Fi network using a USB dongle and at the same time providing a wireless access point to the dongle.

10. Hosting a website on Board: Building and hosting a simple website(static/dynamic) on the device and make it accessible online. There is a need to install server (eg: Apache) and thereby host the website.
11. Webcam Server: Interfacing the regular USB webcam with the device and turn it into fully functional IP webcam &test the functionality.
12. FM Transmission: Transforming the device into a regular FM transmitter capable of transmitting audio at desired frequency (generally 88-108 MHz)

Lab Requirements:

Software:

Keil / Python

Hardware:

Arduino/Raspberry Pi/Beagle bone.

2552253	M.Tech., II-SEMESTER COMPREHENSIVE VIVA VOCE (POWER SYSTEMS)	L	T	P	C
		0	0	0	2

Pre-Requisites: All Courses

Course Outcomes:

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

CO1. Demonstrate comprehensive understanding of core concepts learned throughout the program.

CO2. Apply theoretical knowledge to analyze and solve discipline-specific problems.

CO3. Communicate technical ideas, concepts, and project outcomes clearly and effectively during oral examination.

CO4. Integrate knowledge from various subjects to justify solutions and decisions.

CO5. Exhibit critical thinking, professional ethics, and confidence while responding to technical and situational questions.

		L	T	P	C
2598281	**M.Tech., II-SEMESTER** **QUANTUM TECHNOLOGIES AND APPLICATIONS** (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) **(MANDATORY COURSE-II)**	**2**	**0**	**0**	**2**

Pre-Requisites: NIL

Course Outcomes:

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

CO1. Demonstrate the basic principles and technological importance of quantum physics.

CO2. Explain the basic concepts of qubits, quantum states, entanglement, and differences between classical and quantum information systems..

CO3. Analyze the key challenges and requirements in developing stable and scalable quantum hardware systems.

CO4. Explain the basic concepts of quantum communication and computing, including QKD, quantum parallelism, and related challenges.

CO5. Demonstrate the major applications, industry developments, and future opportunities of quantum technologies along with their societal and practical challenges.

SYLLABUS:

UNIT-I: FOUNDATIONS OF QUANTUM THEORY AND TECHNOLOGIES (05 Periods)

Transition from classical to quantum physics. Key conceptual principles: Superposition, Entanglement, Uncertainty, Wave-particle duality. Quantum states and measurement; the role of the observer. Representative quantum systems: electrons, photons, atoms. Concept of quantization and discrete energy levels. Strategic relevance of quantum technologies.

Overview of major domains: Computing, Communication, Sensing. Global quantum initiatives: India's National Quantum Mission, EU Quantum Flagship, USA, China.

UNIT-II: CONCEPTUAL STRUCTURE OF QUANTUM INFORMATION (07 Periods)

Qubits: qualitative understanding using spin and polarization. Classical bits vs quantum bits: distinctions and implications. Quantum systems (non-engineering perspective): trapped ions, superconducting qubits, photonics. Coherence and decoherence mechanisms. Abstract notions: quantum states, measurement operators, Hilbert space—interpretation without mathematics. Entanglement and non-locality as foundational resources. Quantum vs classical information principles; philosophical considerations.

UNIT-III: BUILDING A QUANTUM COMPUTER – CHALLENGES AND REQUIREMENTS (06 Periods)

Conceptual prerequisites for functional quantum hardware. Fragility of quantum states: decoherence, noise, stability issues. Requirements: isolation, error resilience, scalability, control. Why maintaining entanglement is difficult; theoretical necessity of quantum error correction. Comparative overview of hardware platforms (superconducting circuits, trapped ions, photonics).Current progress vs scientific constraints; conceptual view of quantum software's role.

UNIT-IV: QUANTUM COMMUNICATION AND COMPUTING (06 Periods)

Quantum vs classical communication paradigms. Essentials of Quantum Key Distribution (QKD) and its security rationale. Entanglement- enabled communication protocols. Concept of the Quantum Internet and secure global networking. Introduction to quantum computing and quantum

parallelism.
Conceptual comparison of classical and quantum gate operations. Challenges: decoherence, noise, and the necessity of error correction frameworks.

UNIT-V: APPLICATIONS, INDUSTRY, AND FUTURE DIRECTIONS (06 Periods)

Application domains: Healthcare and drug discovery, Material science and chemistry, Optimization and logistics, Quantum sensing and precision timing. Case studies: IBM, Google, Microsoft, PsiQuantum. Ethical, societal, and policy considerations. Barriers to adoption: cost, skilled workforce, standards. Emerging research and career landscapes; India's strategic opportunity in the global quantum ecosystem.

Total Periods: 30

Textbooks:

T1. Quantum Computation and Quantum Information, Nielsen & Chuang, Cambridge University Press, 2010.
T2. Quantum Computing: A Gentle Introduction, Rieffel & Polak, MIT Press, 2011.
T3. Quantum Computing for Everyone, Chris Bernhardt, MIT Press, 2019.

Reference Books:

R1. Quantum Computing Explained, David McMahon, Wiley, 2008.
R2. An Introduction to Quantum Computing, Kaye, Laflamme, Mosca, OUP, 2007.
R3. Quantum Computing Since Democritus, Scott Aaronson, CUP, 2013.
R4. Quantum Mechanics: The Theoretical Minimum, Susskind & Friedman, Basic Books, 2014.
R5. Quantum Enigma, Rosenblum & Kuttner, OUP, 2011.
R6. Principles of Quantum Computation and Information, Benenti et al., World Scientific, 2004.
R7. DST India and MeitY: Official Quantum Mission Reports, 2020 onwards.
R8. Quantum Flagship EU: Roadmaps and Strategy Documents.

Online Learning Resources

1. IBM Quantum Experience & Qiskit Textbook Coursera – Quantum Mechanics and Quantum Computation (UC Berkeley) edX – Quantum Internet & Quantum Computers
2. YouTube – Quantum Computing for the Determined (Michael Nielsen)

25HS201	M.Tech., II-SEMESTER PEDAGOGY STUDIES (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) (AUDIT COURSE-II)	L	T	P	C
		2	0	0	0

Pre-Requisites: NIL

Course Outcomes:

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

CO1. Apply pedagogy, learning theories, and technology to design learner-centered education.

CO2. Design and implement effective lesson plans and curriculum using appropriate teaching strategies and technology tools to enhance the teaching–learning process.

CO3. Analyze and apply instructional design models, emerging e-learning trends, and ICT tools to design and implement effective technology-integrated teaching–learning systems.

CO4. Apply pedagogical analysis and appropriate assessment methods, including technology-based tools and reflective practices, to improve teaching–learning effectiveness.

CO5. Apply pedagogical analysis and appropriate assessment methods, including technology-based tools and reflective practices, to improve teaching–learning effectiveness.

SYLLABUS:

UNIT-I: FOUNDATIONS OF PEDAGOGY (05 Periods)

Introduction to pedagogy and its importance in education - Historical and philosophical foundations of pedagogy - Theories of learning and teaching (behaviorist, cognitive, constructivist) - Role of pedagogy in shaping educational practices - Role of technology in modern pedagogy (ICT, e-learning, blended learning)

UNIT-II: TEACHING-LEARNING PROCESSES (06 Periods)

Understanding the teaching-learning process - Lesson planning and curriculum design - Strategies for effective teaching and learning (expository, collaborative, experiential) - Use of technology to enhance teaching-learning processes (multimedia, simulations, gamification)

UNIT-III: TECHNOLOGY INTEGRATION IN EDUCATION (07 Periods)

Educational technology and system design - Instructional design models (ADDIE, ASSURE, Dick and Carey Model) - Emerging trends in e-learning (social learning, MOOCs, mobile learning) - ICT tools for teaching and learning (Learning Management Systems, online resources)

UNIT-IV: PEDAGOGY AND ASSESSMENT (06 Periods)

Pedagogy, pedagogical analysis, and assessment - Types of assessment (placement, formative, diagnostic, summative) - Technology-based assessment tools (online quizzes, polls, discussions) - Rubrics for self and peer evaluation- Reflective Practices

UNIT-V: CONTEMPORARY ISSUES AND TRENDS (06 Periods)

Inclusive education and technology (assistive technology, accessibility) - Change management and innovation in education - Quality assurance and evaluation in education (TQM, Six Sigma) - Future trends in pedagogy and technology (AI, AR, VR in education) - Personalized learning and adaptive teaching

Total Periods: 30

Text Books:

T1. Alexander, R. J. Essays on Pedagogy. Routledge, 2008.
T2. Shulman, L. S. The Wisdom of Practice: Essays on Teaching, Learning, and Learning to Teach. Jossey-Bass, 2004

Reference Books:

R1. Teaching for the Future: Effective Teacher Education and Pedagogical Practices. OECD Publishing., 2021
R2. Fullan, M., & Edwards, M. System Change in Education: Sustainability and Impact. Routledge, 2022.
R3. Coe, R., Rauch, C., Kime, S., & Singleton, D. Great Teaching Toolkit: Evidence Review. Evidence Based Education., 2020
R4. Zeichner, K. M. The Struggle for the Soul of Teacher Education. Routledge, 2024
R5. UNESCO. Global Education Monitoring Report: Pedagogy, Teachers and Learning. UNESCO Publishing, 2024
R6. Hattie, J. Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement. Routledge., 2009
R7. Darling-Hammond, L. Teacher Education Around the World: What Can We Learn from International Practice? Routledge, 2007

Online Resources:

1. UNESCO Education Resources – https://www.unesco.org/education
2. OECD Education and Skills – https://www.oecd.org/education
3. ERIC (Education Resources Information Center) – https://eric.ed.gov (peer-reviewed papers, reports).
4. World Bank Education – https://www.worldbank.org/en/topic/education (research reports on teacher development in developing countries).
5. NPTEL/SWAYAM MOOCs – Teacher education and pedagogy-focused courses.
6. Google Scholar Alerts – set alerts for "pedagogical practices", "teacher education", "curriculum research" for the latest academic papers.

		L	T	P	C
25HS202	**M.Tech., II-SEMESTER** **PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS** (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) **(AUDIT COURSE-II)**	**2**	**0**	**0**	**0**

Pre-Requisites: NIL

Course Outcomes:

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

CO1. Practice self-awareness and personal effectiveness by analyzing strengths, weaknesses, opportunities, and challenges (SWOC), setting SMART goals, and practicing reflection, journaling, and self-care strategies.

CO2. Evince emotional intelligence by developing self-awareness, self-regulation, motivation, communication, interpersonal, and conflict-resolution skills for personal and professional effectiveness.

CO3. Exhibit a positive mindset, resilience, and emotional well-being by cultivating growth-oriented thinking, gratitude, mindfulness, and strategies to overcome negative thoughts and behaviors.

CO4. Enhance personal and professional effectiveness by developing verbal, non-verbal, and presentation skills, while building confidence and competence in public speaking.

CO5. Demonstrate leadership capabilities by understanding styles and qualities, enhancing teamwork, collaboration, and problem-solving skills for effective team management.

SYLLABUS:

UNIT-I: SELF-AWARENESS AND PERSONAL GROWTH (06 Periods)

Understanding personality and its development- Identifying strengths, weaknesses, opportunities, and challenges (SWOC analysis)- Setting personal and professional goals- Practicing Self-Reflection and Journaling

(Activities: Personality assessments, self reflection exercises, group discussions, SWOC analysis worksheet, Action Plan, SMART goal activities, Reflective journaling, Self-care Planning)

UNIT-II: EMOTIONAL INTELLIGENCE AND INTERPERSONAL SKILLS (06 Periods)

Understanding emotional intelligence and its importance - Developing self-awareness, self-regulation, and motivation - Building effective communication and interpersonal skills - Conflict resolution and negotiation strategies.

(Activities: Emotional Intelligence Quiz, Self-Reflection exercises, feedback sessions, mindfulness exercises, Positive self-talk, Active Listening exercises, conflict-resolution Role-play, Case studies & Group activities)

UNIT-III: POSITIVE THINKING AND ATTITUDE (06 Periods)

Understanding the power of positive thinking- Developing a growth mindset and resilience - Practicing gratitude and mindfulness- Overcoming negative thoughts and behaviors

(Activities on positive thinking, growth mindset, mindfulness and self-care plan for overcoming negative thoughts)

UNIT-IV: EFFECTIVE COMMUNICATION AND PRESENTATION SKILLS (06 Periods)

Understanding the importance of effective communication- Developing verbal and non-verbal communication skills- Preparing and delivering effective presentations- Building confidence and public speaking skills

(Activities: Group discussions, Case studies, Role-Play, Non-verbal communication exercises, Practice presentations, Peer feedback, Public speaking exercises, Storytelling, Debates)

UNIT-V: LEADERSHIP AND TEAMWORK (06 Periods)

Understanding leadership styles and qualities - Developing leadership skills and qualities- Building effective teams and teamwork strategies- Practicing collaboration and problem-solving

(Activities: Case studies, Group discussions, Debates, Leadership role-playing, team building activities, Group projects, Collaborative problem-solving exercies, feedback sessions)

Total Periods: 30

Text Books:

T1. Daniel Goleman, Emotional Intelligence: Why It Can Matter More Than IQ, Bantam Books, 2017.

T2. Stephen R. Covey, The 7 Habits of Highly Effective People, Simon & Schuster, 2020

Reference Books:

R1. Dale Carnegie, How to Win Friends and Influence People, Simon & Schuster, 2020.

R2. Brian Tracy, Goals!: How to Get Everything You Want Faster Than You Ever Thought Possible, Berrett-Koehler Publishers, 2021.

R3. Robin Sharma, The 5 AM Club: Own Your Morning, Elevate Your Life, HarperCollins, 2020.

R4. Carol S. Dweck, Mindset: The New Psychology of Success, Random House, 2016.

R5. Daniel H. Pink,Drive: The Surprising Truth About What Motivates Us, Riverhead Books, 2018.

R6. John C. Maxwell, Leadershift: 11 Essential Changes Every Leader Must Embrace, Harper Collins, 2019.

Online Resources:

1. Coursera – *Personal Development Specialization* (https://www.coursera.org)
2. edX – *Leadership and Emotional Intelligence Courses* (https://www.edx.org)
3. FutureLearn – *Mindfulness and Resilience Training* (https://www.futurelearn.com)
4. MindTools – Practical resources on leadership, communication, and emotional intelligence (https://www.mindtools.com)
5. Positive Psychology – Articles and tools on resilience, gratitude, and well-being (https://positivepsychology.com)
6. TED Talks – Inspirational talks on leadership, communication, and self-growth (https://www.ted.com)
7. Harvard Business Review (HBR) – Leadership, negotiation, and workplace communication (https://hbr.org)

25HS203	M.Tech., II-SEMESTER **YOGA AND MEDITATION** (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) **(AUDIT COURSE-II)**	L	T	P	C
		2	0	0	0

Pre-Requisites: NIL

Course Outcomes:

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

CO1. Explain the eight limbs of Ashtanga Yoga and their significance in achieving physical, mental, and spiritual well-being.

CO2. Explain the principles of Yama and Niyama and their role in ethical and personal discipline in yoga practice.

CO3. Practice the principles of Yama and Niyama as ethical guidelines for disciplined and harmonious living.

CO4. Explain the role of Asana and Pranayama in promoting physical fitness and mental well-being.

CO5. Practice yoga poses and pranayama techniques and their benefits for mind and body.

SYLLABUS:

UNIT-I: ASHTANGA YOGA (05 Periods)

Definitions of Eight parts of yoga - Yama (Restraints / Moral Disciplines), Niyama (Observances / Personal Disciplines), Asana (Postures / Physical Exercises), Pranayama (Breath Control / Life Force Regulation), Pratyahara (Withdrawal of Senses / Sense Control), Dharana (Concentration / Focus), Dhyana (Meditation / Contemplation), Samadhi (Absorption / Liberation)

UNIT-II: YAMA AND NIYAMA IN ASHTANGA YOGA (07 Periods)

Yama (Moral Restraints) - Ahimsa (Non-violence), Satya (Truthfulness), Asteya (Non-stealing), Brahmacharya (Moderation / Celibacy), Aparigraha (Non-possessiveness / Non-greed).

Niyama (Personal Disciplines / Observances) - Shaucha (Cleanliness / Purity), Santosha (Contentment), Tapas (Discipline / Austerity), Swadhyaya (Self-study / Study of Scriptures), Ishwar Pranidhana (Surrender to God / Devotion).

UNIT-III: DO'S AND DON'TS IN LIFE – YAMA AND NIYAMA (06 Periods)

Do‘s and Don‘ts in life.

UNIT-IV: ASANA AND PRANAYAM (06 Periods)

Asana - Body development and steadiness; Pranayam - Breath control and energy regulation

UNIT-V: YOGA POSES AND PRANAYAMA – BENEFITS AND TYPES (06 Periods)

Various yoga poses and their benefits for mind and body

Regularization of breathing techniques and its effects-Types of pranayama

Total Periods: 30

Text Books:

T1. Swami Prabhavananda and Christopher Isherwood (translation & commentary), Patanjali Yoga Sutras,Sri Ramakrishna Math, 1953.

T2. B.K.S. Iyengar, Light on Yoga, Thorsons, 2003.

Reference Books:

R1. T.K.V. Desikachar, The Heart of Yoga: Developing a Personal Practice, Inner Traditions 2nd Edition, 1999.

R2. Acharya Yatendra, Yoga & Stress Management, Fingerprint Publishers, 2019

R3. Yamini Muthanna, The Power of Yoga, Om Books International, 2015.

R4. Nayaswami Devarshi, Kriya Yoga: Spiritual Awakening for the New Age, Ananda Sangha Publications, 2023.

Online Resources:

1. NPTEL / SWAYAM Online Courses – Yoga and Physical Education modules.
2. AYUSH Ministry Website: https://yoga.ayush.gov.in – official yoga resources, protocols, and research.
3. Yoga Journal: https://www.yogajournal.com – practical guides, research updates, asana tutorials.
4. Art of Living Foundation: https://www.artofliving.org – pranayama, meditation, and wellness practices.
5. YouTube Channels (scholarly & practice-based):
    a. Sivananda Yoga Vedanta Centre
    b. Yoga with Adriene (for practical asana guidance)

2584301	M. Tech., III-SEMESTER ADHOC AND WIRELESS SENSOR NETWORKS (EMBEDDED SYSTEMS AND VLSI)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Analyze the characteristics and design issues of Ad Hoc Wireless Networks and their practical challenges.

CO2. Evaluate the performance of different MAC protocols in terms of throughput, delay, fairness, and energy efficiency.

CO3. Assess routing protocol performance based on scalability, routing overhead, QoS support, and energy efficiency.

CO4. Evaluate TCP adaptations and alternative transport layer solutions for reliable communication in dynamic Ad Hoc environments.

CO5. Analyze performance metrics, location discovery mechanisms, evolving standards, and design challenges in Wireless Sensor Networks.

SYLLABUS:

UNIT-I: WIRELESS LANS, PANS AND AD HOC NETWORK FUNDAMENTALS

(08 Periods)

Wireless LANs and PANs: Introduction, Fundamentals of WLANS, IEEE 802.11 Standards, HIPERLAN Standard, Bluetooth, Home RF.

AD HOC WIRELESS NETWORKS: Introduction, Issues in Ad Hoc Wireless Networks.

UNIT-II: MAC PROTOCOL DESIGN FOR AD HOC WIRELESS NETWORKS

(10 Periods)

MAC Protocols: Introduction, Issues in Designing a MAC protocol for Ad Hoc Wireless Networks, Design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols, Contention - Based Protocols, Contention - Based Protocols with reservation Mechanisms, Contention – Based MAC Protocols with Scheduling Mechanisms, MAC Protocols that use Directional Antennas, Other MAC Protocols.

UNIT-III: **ROUTING PROTOCOLS IN AD HOC WIRELESS NETWORKS (09 Periods)**

Routing Protocols: Introduction, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classification of Routing Protocols, Table -Driven Routing Protocols, On – Demand Routing Protocols, Hybrid Routing Protocols, Routing Protocols with Efficient Flooding Mechanisms, Hierarchical Routing Protocols, Power - Aware Routing Protocols.

UNIT-IV: TRANSPORT LAYER PROTOCOLS FOR AD HOC NETWORKS (09 Periods)

Transport Layer Protocols: Introduction, Issues in Designing a Transport Layer Protocol for Ad Hoc Wireless Networks, Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks, Classification of Transport Layer Solutions, TCP Over Ad Hoc Wireless Networks, Other Transport Layer Protocol for Ad Hoc Wireless Networks.

UNIT-V: WIRELESS SENSOR NETWORKS ARCHITECTURE AND PROTOCOLS

(09 Periods)

Wireless Sensor Networks: Introduction, Sensor Network Architecture, Data Dissemination, Data Gathering, MAC Protocols for Sensor Networks, Location Discovery, Quality of a Sensor Network, Evolving Standards, Other Issues.

Total Periods: 45

Textbooks:

T1. Ad Hoc Wireless Networks: Architectures and Protocols - C. Siva Ram Murthy and B. S.

Manoj, 2004, PHI.
T2. Wireless Ad- hoc and Sensor Networks: Protocols, Performance and Control-Jagannathan Sarangapani, CRC Press.

Reference Books

R1. Ad- Hoc Mobile Wireless Networks: Protocols & Systems, C. K. Toh, 1st Ed. Pearson Education.
R2. Wireless Sensor Networks - C. S. Raghavendra, Krishna M. Sivalingam, 2004, Springer.

2584302	M. Tech., III-SEMESTER VLSI SIGNAL PROCESSING (EMBEDDED SYSTEMS AND VLSI)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Design and optimize DSP architectures by applying different techniques for high-speed and low-power implementations

CO2. Analyze and optimize DSP architectures by applying folding techniques, to reduce hardware complexity and improve system performance.

CO3. Design and analyze systolic architectures for DSP applications

CO4. Analyze and design fast convolution architectures to DSP system performance.

CO5. Analyze and design low-power DSP architectures with energy-efficient implementations.

SYLLABUS:

UNIT-I: INTRODUCTION (09 Periods)

Introduction to DSP: Typical DSP algorithms, DSP algorithms benefits, Representation of DSP algorithms Pipelining and Parallel Processing Introduction, Pipelining of FIR Digital filters, Parallel Processing, Pipelining and Parallel Processing for Low Power Retiming Introduction, Definitions and Properties, Solving System of Inequalities, Retiming Techniques

UNIT-II: FOLDING AND UNFOLDING (09 Periods)

Folding - Introduction, Folding Transform, Register minimization Techniques, Register minimization in folded architectures, folding of Multi rate systems Unfolding-Introduction, An Algorithm for Unfolding, Properties of Unfolding, critical Path, Unfolding and Retiming, Applications of Unfolding.

UNIT-III: **SYSTOLIC ARCHITECTURE DESIGN (09 Periods)**

Introduction, Systolic Array Design Methodology, FIR Systolic Arrays, Selection of Scheduling Vector, Matrix Multiplication and 2D Systolic Array Design, Systolic Design for Space Representations contain Delays.

UNIT-IV: FAST CONVOLUTION (09 Periods)

Introduction – Cook - Toom Algorithm – Winograd algorithm – Iterated Convolution – Cyclic Convolution – Design of Fast Convolution algorithm by Inspection.

UNIT-V: LOW POWER DESIGN (09 Periods)

Digital lattice filter structures, bit level arithmetic, architecture, redundant arithmetic. Numerical strength reduction, synchronous, wave and asynchronous pipe lines, Scaling Vs Power Consumption, Power Analysis, Power Reduction techniques, Power Estimation Approaches

Total Periods: 45

Textbooks:

T1. Keshab K. Parthi, VLSI Digital Signal Processing- System Design and Implementation, Wiley Inter Science, 1998.

T2. T2. Kung S. Y, H. J. While House, T. Kailath, VLSI and Modern Signal processing, Prentice Hall,1985.

Reference Books

R1. Jose E. France, Yannis Tsividis, Design of Analog – Digital VLSI Circuits for Telecommunications and Signal Processing, Prentice Hall, 1994.
R2. Medisetti V. K, VLSI Digital Signal Processing, IEEE Press (NY), 1995

2584303	M. Tech., III-SEMESTER INDUSTRIAL INTERNET OF THINGS (EMBEDDED SYSTEMS AND VLSI)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES:

After completion of the course, student will be able to

CO1. Analyze the architecture and applications of Industrial IoT systems including sensors, device placement, and communication systems.

CO2. Examine operating systems, networking models, and wireless protocols used in IIoT deployments.

CO3. Apply data-driven analytics and basic machine learning techniques for industrial IoT data processing.

CO4. Compare IP and Non-IP communication protocols and select appropriate protocols for IIoT applications.

CO5. Design IIoT-based solutions integrating cloud platforms, localization techniques, and robotic systems.

SYLLABUS:

UNIT-I: INTRODUCTION IIoT: MARKET SIZE AND POTENTIAL (09 Periods)

Definition, IoT v IIoT, Next Generation Sensors, Sensor‘s calibration and validate sensor measurements, placement of IoT devices, sensors, low-cost communication system design, Top application areas include manufacturing, oil & gas, Embedded systems in the Automotive and Transportation market segment.

UNIT-II: IIoT METHODOLOGY (09 Periods)

Top operating systems used in IIoT deployments, Networking and wireless communication protocols used in IIoT deployments. Smart Remote Monitoring Unit, components of monitoring system, control and management, Wireless Sensor Network (WSN)**.**

UNIT-III: **R DATA DRIVEN ANALYTICS OF IIoT (09 Periods)**

Implementing of industrial IoT Data flow, big data and how to prepare data for machine learning algorithms, Machine Learning algorithms, supervised learning & Un-supervised learning algorithms, Basics of neural network, activation functions, back-propagation.

UNIT-IV: IP AND NON-IP PROTOCOLS FOR IoT (08 Periods)

WPAN, IEEE 802.15.4, Bluetooth, NFC, 6LoWPAN; RFID, Zigbee Wireless HART Protocol, MQTT, IP and Non-IP Protocols, REST, CoAP.

UNIT-V: IoT CLOUDS AND DATA ANALYTICS (10 Periods)

Develops a physics-based and data-driven digital equipment model to monitor assets and systems, Introduction to device localization and tracking; different types of localization techniques, Radio-Frequency Identification (RFID) and fingerprinting, Device diversity/heterogeneity issue in IIoT networks.

Internet of Robotic Things (IoRT): Introduction to stationary and mobile robots, Brief introduction to localization, mapping, planning, and control of robotic systems; Introduction to cloud-enabled robotics; Applications of IIoT in robotics; Architectures for IoRT, Examples and case studies: Open issues and challenges.

Total Periods: 45

Textbooks:

T1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017.

T2. Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press,2015.
T3. "Industry 4.0: The Industrial Internet of Things", Alasdair Gilchrist, Apress, 2016
T4. Introduction to Industrial Internet of Things and Industry 4.0‖, Sudip Misra, Chandana Roy, Anadarup Mukherjee, CRC Press,2021

Reference Books:

R1. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012.
R2. "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.
R3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer, 2011.
R4. Hands on Industrial Internet of Things, Giacomo Veneri, Antonio Capasso, Packt Press, 2018.

2584351	M.Tech., III-SEMESTER DISSERTATION PHASE–I (EMBEDDED SYSTEMS AND VLSI)	L	T	P	C
		0	0	20	10

Pre-Requisites: NIL

Course Outcomes:

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

CO1. Identify and formulate a research problem in the chosen area of specialization through comprehensive literature review.

CO2. Analyze existing methods and technologies related to the problem and identify research gaps.

CO3. Design a suitable methodology, framework, or experimental setup to address the identified research problem.

CO4. apply appropriate tools and techniques to understand and analyze the problems following professional ethics with focus on societal and environmental aspects.

CO5. prepare and present a detailed project proposal and preliminary results effectively through technical reports and seminars.

CO6. make decisions to manage tasks and also engage in independent and life-long learning with ability to adapt to new and technological changes.

2584352	M.Tech., III-SEMESTER INDUSTRY INTERNSHIP (EMBEDDED SYSTEMS AND VLSI)	L	T	P	C
		0	0	0	2

Pre-Requisites: All Courses

Course Outcomes:

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

CO1. Demonstrate the organizational structure, workflow, and professional practices followed in industry.

CO2. Apply engineering knowledge and technical skills to solve real-world industrial problems.

CO3. Develop professional competencies such as teamwork, communication, time management, and work ethics in an industrial environment.

CO4. Prepare and present a comprehensive report reflecting practical learning, observations, and outcomes.

2584353	M.Tech., III-SEMESTER CO-CURRICULAR ACTIVITIES (EMBEDDED SYSTEMS AND VLSI)	L	T	P	C
		0	0	0	1

Pre-Requisites: NIL

Course Outcomes:

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

CO1. Demonstrate participation and engagement in technical and professional co-curricular activities such as seminars, workshops, competitions, and technical events.

CO2. Develop problem-solving, analytical, and innovation skills through active involvement in technical activities.

CO3. Enhance communication, leadership, teamwork, and organizational skills through collaborative participation in co-curricular programs.

CO4. Apply acquired knowledge and skills to improve overall professional competence and lifelong learning abilities.

2512381	M.Tech., III-SEMESTER GREEN BUILDINGS (Common to AIDS, PS, RE, ES&VLSI) (OPEN ELECTIVE)	L	T	P	C
		3	0	0	3

Pre-Requisites: NIL

Course Outcomes:

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

CO1. Apply principles of green building design to plan and evaluate sustainable buildings by integrating energy efficiency, water conservation, eco-friendly materials, and sustainable construction practices.

CO2. Explain green building concepts, rating systems, and sustainable practices for energy, water, and materials efficiency.

CO3. Apply green building design principles to reduce energy demand and integrate renewable and onsite energy systems efficiently.

CO4. Apply energy-efficient HVAC design principles for sustainable air conditioning and green building performance.

CO5. Apply material conservation strategies and indoor environmental quality principles to promote sustainable and healthy buildings.

SYLLABUS:

UNIT-I: INTRODUCTION TO GREEN BUILDING AND SUSTAINABLE FEATURES

(08 Periods)

Introduction to Green Building – Necessity of Green Buildings, Benefits of Green Buildings, Green Building Materials and Equipment in India, Key Requisites for Constructing a Green Building, Important Sustainable Features for Green Buildings.

UNIT-II: GREEN BUILDING CONCEPTS AND SUSTAINABLE PRACTICES

(09 Periods)

Green Building Concepts and Practices – Indian Green Building Council, Green Building Movement in India, Benefits Experienced in Green Buildings, Launch of Green Building Rating Systems, Residential Sector, Market Transformation; Green Building Opportunities and Benefits: Opportunities of Green Buildings, Green Building Features, Material and Resources, Water Efficiency, Optimum Energy Efficiency, Typical Energy-Saving Approaches in Buildings, LEED India Rating System, and Energy Efficiency.

UNIT-III: GREEN BUILDING DESIGN AND ENERGY OPTIMIZATION

(09 Periods)

Green Building Design – Introduction, Reduction in Energy Demand, Onsite Sources and Sinks, Maximizing System Efficiency, Steps to Reduce Energy Demand and Use Onsite Sources and Sinks, Use of Renewable Energy Sources, Eco-friendly Captive Power Generation for Factories, Building Requirements.

UNIT-IV: AIR CONDITIONING AND ENERGY-EFFICIENT BUILDING SYSTEMS

(09 Periods)

Air Conditioning – Introduction, CII Godrej Green Business Centre, Design Philosophy, Design Interventions, Energy Modeling, HVAC System Design, Chiller Selection, Pump Selection, Selection of Cooling Towers, Selection of Air Handling Units, Pre-cooling of Fresh Air, Interior

Lighting Systems, Key Features of the Building, Eco-friendly Captive Power Generation for Factories, Building Requirements.

UNIT-V: MATERIAL CONSERVATION AND INDOOR ENVIRONMENTAL QUALITY (09 Periods)

Material Conservation – Handling of Non-Process Waste, Waste Reduction During Construction, Materials with Recycled Content, Local Materials, Material Reuse, Certified Wood, Rapidly Renewable Building Materials and Furniture. Indoor Environment Quality and Occupational Health – Air Conditioning, Indoor Air Quality, Sick Building Syndrome, Tobacco Smoke.

Total Periods: 45

Text Books:

T1. Handbook on Green Practices published by Indian Society of Heating Refrigerating and Air conditioning Engineers, 2009.

T2. Green Building Hand Book , Tomwoolley and Samkimings, 2009.

References:

R1. Complete Guide to Green Buildings, Trish riley

R2. Standard for the design for High Performance Green Buildings, Kent Peterson, 2009

R3. Energy Conservation Building Code –ECBC-2020, BEE.

2512382	M.Tech., III-SEMESTER ROAD SAFETY ENGINEERING (Common to AIDS, PS, RE, ES&VLSI) (OPEN ELECTIVE)	L	T	P	C
		3	0	0	3

Pre-Requisites: NIL

Course Outcomes:

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

CO1. Analyze accident data to identify causes and recommend safety improvements.

CO2. Apply statistical methods to analyze traffic data and improve accident prevention measures.

CO3. Analyze vehicle, human, and geometric design factors to recommend safe road design and traffic control measures.

CO4. Classify traffic signs and road markings and evaluate their design and role in enhancing road safety.

CO5. Evaluate traffic management systems, road safety audit processes, and ITS applications to improve road safety performance.

SYLLABUS:

UNIT-I: ACCIDENT INVESTIGATION AND ROAD SAFETY RISK MANAGEMENT

(08 Periods)

Accident Investigations and Risk Management, Collection of Accident Data, Assessment of Road Safety, Methods to Identify and Prioritize Hazardous Locations and Elements, Determine Possible Causes of Crashes, Crash Reduction Capabilities and Countermeasures, Effectiveness of Safety Design Features, Accident Reconstruction, Condition and Collision Diagram.

UNIT-II: TRAFFIC ENGINEERING AND STATISTICAL ANALYSIS IN ROAD SAFETY

(09 Periods)

Traffic Engineering Studies; Statistical Methods In Traffic Safety Analysis – Regression Methods, Poisson Distribution, Chi- Squared Distribution, Statistical Comparisons- Traffic Management Measures And Their Influence On Accident Prevention.

UNIT-III: ROAD SAFETY IN TRANSPORT PLANNING AND GEOMETRIC DESIGN

(09 Periods)

Road Safety in ` Transport Planning and Geometric Design: Vehicle and Human Characteristics, Road Design and Safety Elements, Redesigning Junctions, Cross Section Improvements, Traffic Control, Traffic Calming Measures, Road Safety Furniture

UNIT-IV: ROLE OF SIGNS AND MARKINGS IN SAFETY

(08 Periods)

Types of Signs – Design Specifications – Guidelines for Installation – Role of Signs in Safety; Types of Road Markings – Design Specifications – Role of Road Markings in Safety.

UNIT-V: TRAFFIC MANAGEMENT SYSTEMS AND ROAD SAFETY AUDIT

(10 Periods)

Traffic Management Systems for Safety, Road Safety Audits and Tools for Safety Management Systems, Road Safety Audit Process, Road Safety Improvement Strategies, ITS and Safety.

Total Periods: 45

Text Books:

T1. Traffic Engineering and Transportation Planning, L.R. Kadiyali, Khanna Publishers

T2. Fundamentals of Transportation Engineering, C.S.Papacostas, Prentice Hall India.

T3. Road Safety by NCHRP

References:

R1. Transportation Engineering - An Introduction, C.Jotin Khisty, B. Kent Lall

R2. Fundamentals of Traffic Engineering, Richardo G Sigua

R3. Handbook of Road Safety Measures, Second Edition, Rune Elvik, Alena Hoye, TrulsVaa, Michael Sorenson

		L	T	P	C
2598381	**M.Tech., III-SEMESTER** **ADVANCED DATA STRUCTURES AND ALGORITHMS** (Common to PS, Geo-Tech, RE, ES&VLSI) **(OPEN ELECTIVE)**	**3**	**0**	**0**	**3**

Pre-Requisites: NIL

Course Outcomes:

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

CO1. Implement and manipulate linear data structures like singly/doubly linked lists, circular lists, stacks, and queues using dynamic memory allocation.

CO2. Apply and analyze searching and sorting algorithms including linear, binary search, bubble, selection, insertion, quick, and merge sort.

CO3. Design and implement dictionaries and hashing techniques to efficiently store and retrieve data.

CO4. Construct and operate on trees and priority queues, performing insertion, deletion, and traversal operations.

CO5. Compare and implement balanced search trees (AVL, Red-Black, Splay, B-Trees) for optimized data access and storage.

SYLLABUS:

UNIT-I: INTRODUCTION **(09 Periods)**

Introduction to Data Structures, Singly Linked Lists, Doubly Linked Lists, Circular Lists-Algorithms. Stacks and Queues: Algorithm Implementation using Linked Lists.

UNIT-II: SEARCHING AND SORTING **(09 Periods)**

Linear and Binary Search Methods, Sorting: -Basic sorting techniques, Radix Sort, Bucket Sort, Shell Sort Trees- Binary trees, Properties, Representation and Traversals, Expression Trees (Infix, prefix, postfix). Graphs-Basic Concepts, Storage structures and Traversals.

UNIT-III: DICTIONARIES AND HASHING **(09 Periods)**

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

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

UNIT-IV: PRIORITY QUEUES **(09 Periods)**

Definition, ADT, Realizing a Priority Queue Using Heaps, Definition, Insertion, Deletion .Search Trees- Binary Search Trees, Definition, ADT, Implementation, Operations-Searching, Insertion, Deletion.

UNIT-V: SEARCH TREES **(09 Periods)**

AVL Trees, Definition, Height of AVL Tree, Operations-, Insertion, Deletion and Searching, Introduction to Red-Black and Splay Trees, B-Trees, Height of B-Tree, Insertion, Deletion and Searching, Comparison of Search Trees.

Total Periods: 45

Text Books:

T1. Data Structures: A Pseudo Code Approach, Richard F.Gilberg, Behrouz A. Forouzon and Cengage, 2/e.

T2. Data Structures, Algorithms and Applications in java, SartajSahni, University Press, 2/e.

Reference Books:

R1. Data Structures and Algorithm Analysis, Mark Allen Weiss, Pearson, 2/e.

R2. Data Structures and Algorithms, Adam Drozdek, Cengage, 3/e,

R3. C and Data Structures: A Snap Shot Oriented Treatise using Live Engineering Examples, N.B.Venkateswarulu, E.V.Prasad and S Chand & Co.

	M.Tech., III-SEMESTER	L	T	P	C
2598382	**CLOUD COMPUTING** (Common to PS, Geo-Tech, RE, ES&VLSI) **(OPEN ELECTIVE)**	**3**	**0**	**0**	**3**

Pre-Requisites: NIL

Course Outcomes:

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

CO1. Explain cloud computing fundamentals including characteristics, deployment and service models, multitenancy, cloud economics, networking role, and platforms such as Amazon EC2, Google App Engine, and Microsoft Azure.

CO2. Demonstrate virtualization concepts including server, storage, network and service virtualization, virtual machines, virtualization management, performance measurement, and hypervisors such as KVM, Xen, and VMware ESXi.

CO3. Explain relational databases, cloud file systems such as Google File System and Hadoop Distributed File System, data models including Bigtable, Apache HBase, Amazon Dynamo, and the MapReduce model with its parallel computing efficiency.

CO4. Explain cloud security fundamentals, including security architecture, vulnerability assessment, privacy, trusted computing, secure execution environments, identity and access management, and autonomic security.

CO5. Analyze issues in cloud computing including real-time application deployment, inter-cloud challenges, QoS and monitoring, dependability, data migration, streaming, and the role of cloud middleware.

SYLLABUS:

UNIT-I: CLOUD COMPUTING FUNDAMENTALS (09 Periods)

Definition, characteristics, components, Cloud service provider, the role of networks in Cloud computing, Cloud deployment models- private, public & hybrid, Cloud service models, multitenancy, Cloud economics and benefits, Cloud computing platforms - IaaS: Amazon EC2, PaaS: Google App Engine, Microsoft Azure, SaaS.

UNIT-II: VIRTUALIZATION TECHNOLOGIES (09 Periods)

Virtualization concepts, Server virtualization, Storage virtualization, Storage services, Network virtualization, Service virtualization, Virtualization management, Virtualization technologies and architectures, virtual machine, Measurement and profiling of virtualized applications. Hypervisors: KVM, Xen, VMware hypervisors and their features.

UNIT-III: DISTRIBUTED DATA MANAGEMENT AND PROCESSING (09 Periods)

Relational databases, Cloud file systems: GFS and HDFS, Bigtable, HBase and Dynamo. MapReduce and extensions: Parallel computing, the map -Reduce model, Parallel efficiency of Map Reduce.

UNIT-IV: CLOUD SECURITY (09 Periods)

Cloud security fundamentals, Vulnerability assessment tool for cloud, Privacy and Security in cloud. Cloud computing security architecture: General Issues, Trusted Cloud computing, Secure Execution Environments and Communications, Micro - architectures; Identity Management and Access control, Autonomic security.

UNIT-V: ADVANCED CLOUD COMPUTING ISSUES (09 Periods)

Issues in cloud computing Implementing real time application over cloud platform, Issues in Inter - cloud environments, QOS Issues in Cloud, Dependability, data migration, streaming in Cloud. Quality of Service (QoS) monitoring in a Cloud computing environment. Cloud Middleware.

Total Periods: 45

Text Books:

T1. Enterprise Cloud Computing, Gautam Shroff, Cambridge publication.

T2. Enterprise Cloud Computing Technology Architecture Applications, Gautam Shroff, Cambridge University Press; 1 edition, [ISBN: 978-0521137355], 2010.

Reference Books:

R1. Cloud Security, Ronald Krutz and Russell Dean Vines, Wiley -India.

R2. Cloud Computing, Dr. Kumar Saurabh, Wiley Publication.

R3. Cloud Computing Strategies, Dimitris N. Chorafas, CRC Press; 1 edition [ISBN: 1439834539],2010

R4. Cloud Computing, A Practical Approach, Toby Velte, Anthony Velte, Robert Elsenpeter, McGraw Hill Osborne Media; 1 edition [ISBN: 0071626948], 2009.

R5. Cloud Computing: Principles and Paradigms, Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley Publication, 2011.

R6. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, Shahed Latif, O'Reilly Media Inc, 2009.

2598383	M.Tech., III-SEMESTER AI TOOLS (Common to PS, Geo-Tech, RE, ES&VLSI) (OPEN ELECTIVE)	L	T	P	C
		3	0	0	3

Pre-Requisites: NIL

Course Outcomes:

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

CO1. Explain the fundamentals and evolution of AI tools.
CO2. Use AI tools for text, language, and communication tasks.
CO3. Apply AI tools for image, audio, and video generation.
CO4. Utilize AI tools for coding, research, and productivity enhancement.
CO5. Analyze ethical, security, and application-oriented aspects of AI tools.

SYLLABUS:

UNIT-I: INTRODUCTION TO AI TOOLS (09 Periods)

Definition of Artificial Intelligence, Evolution of AI and Intelligent Systems, Categories of AI Tools (Generative, Analytical, Assistive), Rule-based vs Learning-based AI Tools, Overview of Machine Learning & Deep Learning Tools, AI Tool Ecosystem (OpenAI, Google, Meta, Microsoft), Cloud-based AI Tools, Future Trends in AI Tool Development.

UNIT-II: TEXT & LANGUAGE AI TOOLS (09 Periods)

Natural Language Processing (NLP) Basics, ChatGPT – Architecture and Capabilities, Prompt Engineering Concepts, AI Tools for Content Writing, AI Tools for Email, Resume & Report Generation, AI-based Translation and Summarization Tools, AI Chatbots and Virtual Assistants, Limitations and Bias in Language AI Tools.

UNIT-III: IMAGE, AUDIO & VIDEO AI TOOLS (09 Periods)

Image Generation Tools (DALL·E, Midjourney, Stable Diffusion), Image Editing and Enhancement using AI, AI Tools for Graphic Design & Posters, Text-to-Speech AI Tools (ElevenLabs, Google TTS), Speech-to-Text AI Tools, AI-based Video Creation Tools, Avatar and Animation AI Tools, Applications in Media, Education & Healthcare.

UNIT-IV: AI TOOLS FOR CODING, RESEARCH & PRODUCTIVITY (09 Periods)

AI Tools for Programming Assistance, Code Generation and Debugging using AI, AI Tools for Data Analysis, AI Tools for Research Paper Writing, AI Tools for Literature Survey and Citations, AI in Project Management, AI Tools for Presentation Creation, AI Tools for Automation and Workflow Optimization.

UNIT-V: ETHICAL, SECURITY & APPLIED AI TOOLS (09 Periods)

Ethical Issues in AI Tool Usage, Data Privacy and Security Concerns, AI Tool Regulations and Policies, AI Tools in Education, AI Tools in Healthcare, AI Tools in Finance and Business, AI Tools in Smart Cities and Governance, Responsible and Sustainable AI Practices.

Total Periods: 45

Text Books:

T1. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, Pearson Education, 4th Edition, 2021.
T2. AI for Everyone, Michael Miller, Pearson, 2020.
T3. Artificial Intelligence for Business, Liam Ottley, Wiley, 2022.

Reference Books:

R1. AI Superpowers: China, Silicon Valley, and the New World Order, Kai-Fu Lee, Houghton Mifflin Harcourt, 2018.

R2. Artificial Intelligence in Practice, Bernard Marr, Wiley, 2020.

R3. Ethical Guidelines for Trustworthy AI, European Commission, 2019.

2584381	M.Tech., III-SEMESTER IOT AND ITS APPLICATIONS (Common to AIDS, PS, Geo-Tech, RE) (OPEN ELECTIVE)	L	T	P	C
		3	0	0	3

Pre-Requisites: NIL

Course Outcomes:

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

CO1. Apply the Knowledge in IOT Technologies and Data management.

CO2. Determine the values chains Perspective of M2M to IOT.

CO3. Implement the state of the Architecture of an IOT.

CO4. Compare IOT Applications in Industrial & real world.

CO5. Demonstrate knowledge and understand the security and ethical issues of an IOT.

SYLLABUS:

UNIT-I: FUNDAMENTALS OF IOT (09 Periods)

Evolution of Internet of Things, Enabling Technologies, IoT Architectures, oneM2M, IoT World Forum (IoTWF) and Alternative IoT models, Simplified IoT Architecture and Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.

IoT Platform overview: Overview of IoT supported Hardware platforms such as: Raspberry pi, ARM Cortex Processors, Arduino and Intel Galileo boards.

UNIT-II: IOT PROTOCOLS (09 Periods)

IT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and Lora WAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks, Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks, Application Transport Methods: Supervisory Control and Data Acquisition, Application Layer Protocols: CoAP and MQTT.

UNIT-III: DESIGN AND DEVELOPMENT (09 Periods)

Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks, Arduino, Board details, IDE programming, Raspberry Pi, Interfaces and Raspberry Pi with Python Programming.

UNIT-IV: DATA ANALYTICS AND SUPPORTING SERVICES (09 Periods)

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest, Role of Machine Learning – No SQL Databases, Hadoop Ecosystem, Apache Kafka, Apache Spark, Edge Streaming Analytics and Network Analytics, Xively Cloud for IoT, Python Web Application Framework, Django, AWS for IoT, System Management with NETCONF-YANG.

UNIT-V: CASE STUDIES/INDUSTRIAL APPLICATIONS (09 Periods)

IoT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipments. Use of Big Data and Visualization in IoT, Industry 4.0 concepts. Sensors and sensor Node and interfacing using any Embedded target boards (Raspberry Pi / Intel Galileo/ARM Cortex/ Arduino).

Total Periods: 45

Text Books:

T1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017.

T2. Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015.

Reference Books:

R1. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012 (for Unit 2).

R2. From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence‖, Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.

R3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer, 2011.

	M.Tech., III-SEMESTER	L	T	P	C
2552381	PHOTOVOLTAIC SYSTEMS (Common to AIDS, Geo-Tech, RE, ES&VLSI) (OPEN ELECTIVE)	3	0	0	3

Pre-Requisites: NIL

Course Outcomes:

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

CO1. Understand solar radiation principles, measurement techniques, and solar cell characteristics and performance.

CO2. Explain solar cell manufacturing technologies, PV module design, encapsulation, power rating, hotspot effect, and design qualification standards.

CO3. Explain flat plate arrays, mounting structures, module interconnection, lightning protection, and performance evaluation including temperature coefficients, series resistance, and curve correction factors.

CO4. Explain photovoltaic system types, design considerations, system, battery and inverter sizing, and balance of system components.

CO5. Explain maximum power point tracking techniques, instrument design, and grid-interactive photovoltaic systems.

SYLLABUS:

UNIT-I: SOLAR ENERGY (09 Periods)

Sun and Earth, Solar Spectrum, Solar Geometry, Solar radiation on horizontal and inclined planes, Instruments for measurement of solar radiation, Solar cell, Equivalent circuit, V-I characteristics, Performance improvement.

UNIT-II: SOLAR CELLS (09 Periods)

Manufacture of Solar Cells-Technologies, Design of Solar cells, Photovoltaic modules, Design requirements, Encapsulation systems, Manufacture, Power rating, Hotspot effect, Design qualifications.

UNIT-III: PROTECTION AND MEASUREMENTS (09 Periods)

Flat plate arrays, Support structures, Module interconnection and cabling, Lightning protection, Performance measurement using natural sun light and simulator, Determination of temperature coefficients, Internal series resistance, Curve correction factor.

UNIT-IV: PHOTOVOLTAIC SYSTEMS (09 Periods)

Photovoltaic systems, Types, General design considerations, System sizing, Battery sizing, Inverter sizing, Design examples, Balance of PV systems.

UNIT-V: MAXIMUM POWER POINT TRACKERS (09 Periods)

Maximum power point trackers, Perturb and observe, Incremental conductance method, Hill climbing method, Hybrid and complex methods, Data based and other approximate methods, Instrument design, Other MPP techniques, Grid interactive PV system.

Total Periods: 45

Text Books:

T1. Generating electricity from Sun, F.C.Treble, Pergamon Press.

T2. Photovoltaic systems: Analysis and design, A.K.Mukherjee, Nivedita Thakur, PHI, 2011.

Reference Books:

R1. Solar Photovoltaics: Fundamentals, Technologies and applications, C.S.Solanki, PHI, 2009.

Online Learning Resources:

1. https://nptel.ac.in/courses/117108141

		L	T	P	C
2599381	**M.Tech., III-SEMESTER** **INTEGRATED PRODUCT DESIGN AND DEVELOMENT** (Common to AIDS, PS, Geo-Tech, ES&VLSI) **(OPEN ELECTIVE)**	**3**	**0**	**0**	**3**

Pre-Requisites: NIL

Course Outcomes:

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

CO1. Explain design concepts, product development planning and customer requirements

CO2. Generate the concept using creative problem solving methods, concept generation and testing.

CO3. Realize Product Teardown, Specifications, Portfolios and Architecture, configurations and prototyping.

CO4. Demonstrate and classify The Design aspects for Risk, Reliability and Safety and environments.

CO5. Do industrial design, understand intellectual property, robust design and product development economics.

SYLLABUS:

UNIT-I: PRODUCT DEVELOPMENT CONCEPTS (09 Periods)

Design Concepts: Design process – Considerations of a good design – Description of good design process – Design codes and standards. Product Development and Planning Process: Characteristics and challenges of product development – Concept development – Generic product development – Product development process flows –Tyco product development – Product development organizations – Organizational structure and design – Product and process cycles – Technological innovation – Structure of opportunity – Opportunity identification – Product planning process – Types of product development projects. **Identifying Customer Needs**: Process of identifying customer needs – Customer requirements.

UNIT-II: CONCEPT SELECTION, GENERATION AND TESTING (09 Periods)

Concept Generation: Activity – Concept generation process – Creativity and problem solving – Creative thinking methods and design – Functional decomposition and synthesis – Morphological methods – Axiomatic design.

Concept Selection and Testing: Development process – Choosing a concept – Concept screening and scoring – Decision making and evaluation – Methods for testing product concepts.

UNIT-III: EMBODIMENT AND DETAIL DESIGN (09 Periods)

Product Teardown, Specifications, Portfolios and Architecture: Teardown process, methods and applications – Post teardown report – Benchmarking approach and support tools for benchmarking process – Product portfolios architecture – Architecture type – Platform architecture – Target Specifications – Setting the final specifications – Modularity – Implications of the architecture – Establishing the architecture – Delayed differentiation – Platform planning – Related system-level design.

Configuration and Detail Design: Generating, analyzing and evaluating configuration design – Best practices for configuration design – Design for X – Design and manufacturing information – Final design review – Activities beyond detail design.

Prototyping: Principles, types and technologies – Understanding prototypes and planning.

UNIT-IV: DESIGN FOR ENVIRONMENT, MANUFACTURING AND SAFETY

(09 Periods)

Design for Manufacture and Environment: Cross-functional team – Overview of DFM process – Life cycles – Environmental impacts – Design for environment process.

Design for Risk, Reliability and Safety: Classification of societal hazards – Standards – Risk assessment – Design for reliability – Causes of unreliability – Minimizing failure – FMEA – Fault tree analysis – Defects and failure modes – Potential dangers – Guidelines for design for safety – Warning labels.

UNIT-V: INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ECONOMICS

(09 Periods)

Industrial Design: Need – Impact – Industrial design process – Management of the industrial design process –Assessing the quality of industrial design. **Robust Design:** Robust design process.

Intellectual Property: Disclosure – Process of pursuing a patent.

Product Development Economics: Elements of economic analysis and process.

Managing Projects: Understanding and representing tasks – Baseline project planning – Accelerating projects – Project execution – Postmortem project evaluation - Project Portfolio Management (PPM) - Earned Value Management (EVM) - Sustainability and ESG in Project Management.

Total Periods: 45

Text Books:

T1. Product Design and Development, Karl T Ulrich, Steven D Eppinger and Maria C. Yang, 7/e, 2020, McGraw-Hill Education Pvt.Ltd., Noida.

T2. Engineering Design, George E.Dieter and Linda C.Schmidt, 4/e, 2013, McGraw-Hill Education Pvt., Ltd., Noida.

Reference Books:

R1. Product Design, Kevin Otto and Kristin Wood, 1/e, 2003, Pearson Education, India.

R2. Product Development, Anil Mital, Anoop Desai, Anand Subramanian and Aashi Mital, 1/e, 2007, Butterworth-Heinemann, Elsevier.

R3. Integrated Product and Process Design and Development: the Product Realization Process (Special Indian Edition), Edward B. Magrab, Satyandra K. Gupta, F. Patrick McCluskey and Peter A. Sandborn, 2/e, 2010, CRC Press, Taylor & Francis Group, LLC.

R4. Product Design for Engineers, Devdas Shetty, 1/e, 2016, Cengage Learning, India.

R5. Introduction to Product Design and Development for Engineers, Ali Jamnia, 2018, CRC Press, Taylor & Francis Group, LLC.

Online Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc25_me121/preview
2. https://onlinecourses.swayam2.ac.in/imb25_mg123/preview

		L	T	P	C
25HS381	**M.Tech., III-SEMESTER** **ADVANCED NUMERICAL METHODS AND COMPUTATIONAL MATHEMATICS** (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) **(OPEN ELECTIVE)**	**3**	**0**	**0**	**3**

Pre-Requisites: NIL

Course Outcomes:

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

- **CO1.** Analyze conditioning, stability, and error behavior of numerical linear algebra routines for dense and sparse problems.
- **CO2.** Derive and apply finite difference for BVP for linear and nonlinear models.
- **CO3.** Derive and apply finite difference for PDE models; assess consistency and stability with Lax equivalence and CFL ideas.
- **CO4.** Optimize engineering models via unconstrained/constrained methods; justify algorithm selection and tuning using theory and diagnostics.
- **CO5.** Integrate GPU/MPI paradigms and the SciPy stack to build scalable, reproducible computational workflows; profile and validate results.

SYLLABUS:

UNIT-I: NUMERICAL LINEAR ALGEBRA (09 Periods)

Floating- point arithmetic, conditioning, stability, backward/forward error; Direct solvers: LU/Cholesky/QR; pivoting and orthogonality; SVD, low- rank approximations, pseudoinverses; Iterative solvers: Jacobi/Gauss–Seidel/CG/GMRES; basic preconditioning; Sparse matrix formats and operations for large- scale systems; Krylov subspace and Arnoldi/Lanczos overviews.

UNIT-II: DISCRETIZATION OF LINEAR AND NONLINEAR ODEs (09 Periods)

Numerical solutions of initial value problems: (single step and multi -step methods); Stability of the numerical methods for initial value problems; Boundary value problems; shooting method; Finite difference for BVP (second and higher order methods), for linear and nonlinear problems Consistency–stability–convergence.

UNIT-III: DISCRETIZATION OF LINEAR AND NONLINEAR PDEs (09 Periods)

Finite difference methods for parabolic problems explicit and implicit methods, Finite difference for hyperbolic explicit and implicit methods; Elliptic PDE; Consistency, Stability and convergence; Lax equivalence and CFL (Courant–Friedrichs–Lewy) ideas; Iterative solvers and multigrid overview for discretized systems.

UNIT-IV: NUMERICAL OPTIMIZATION AND INVERSE PROBLEMS (09 Periods)

Unconstrained methods: gradient, Newton, quasi- Newton, trust- region; Constrained methods: KKT conditions, interior- point, SQP principles; Nonlinear least squares: Gauss–Newton and Levenberg–Marquardt; Regularization (Tikhonov/L1) and model selection concepts; Scientific Python stack:scipy.optimize.minimize, scipy.optimize.linprog, and scipy.optimize.curve_fit; solver choice and diagnostics.

UNIT-V: HIGH- PERFORMANCE SCIENTIFIC COMPUTING (09 Periods)

Parallel paradigms: data/task parallelism; domain decomposition fundamentals; GPU programming model: threads/warps/memory hierarchy; CUDA libraries; MPI and PETSc for scalable sparse linear

algebra and time- steppers; Performance engineering: profiling, locality, and roofline- style thinking; Python at scale: NumPy/SciPy sparse and vectorization; brief Numba/CuPy ecosystem; end-to-end case sketches in CFD/structures/machine learning numerics.

Total Periods: 45

Text Books:

T1. Numerical Linear Algebra, Trefethen, L. N., and D. Bau III, Twenty- Fifth Anniversary Edition, SIAM, 2023.

T2. Finite Difference Methods for Ordinary and Partial Differential Equations: Steady- State and Time-Dependent Problems, LeVeque, R. J., SIAM, 2007.

T3. Numerical Optimization, Nocedal, J., and S. J. Wright, 2nd ed., Springer, 2006.

Reference Books:

R1. Programming Massively Parallel Processors: A Hands- on Approach, Hwu, W.- M. W., and D. B. Kirk, 4th ed., Elsevier, 2022.

R2. Numerical linera algebra and Application, B. N. dutta, Springer Publications.

R3. SciPy Project, Optimization (scipy.optimize), SciPy Manual and Optimization and Root Finding, SciPy 1.16.2 (stable) Reference.

R4. PETSc/TAO Users Manual, Balay, S., et al. Argonne National Laboratory, ANL-21/39 Rev 3.18release documentation.

R5. Automated Solution of Differential Equations by the Finite Element Method: The FEniCS Book. Logg, A., K.- A. Mardal, and G. N. Wells (eds.). Berlin: Springer, 2012.

R6. Numerical analysis Mathematics of scientific computing, David Kincaid Ward Chenery, AMS Book publishers.

R7. Computational Methods for Partial Differential Equations, M. K. Jain, S. R. K. Iyengar and R. K. Jain, New Age publications.

		L	T	P	C
25HS382	**M.Tech., III-SEMESTER** **MATHEMATICS FOR MACHINE LEARNING AND DATA SCIENCE** (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) **(OPEN ELECTIVE)**	**3**	**0**	**0**	**3**

Pre-Requisites: NIL

Course Outcomes:

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

CO1. Analyze linear models and matrix factorizations for dimensionality reduction and feature representation.

CO2. Formulate and solve convex and constrained optimization problems; compare first- and second-order methods.

CO3. Apply probabilistic modeling, Bayesian inference, and information- theoretic measures to estimation and generalization.

CO4. Prove convergence properties or error bounds for selected learning algorithms such as SGD and regularized estimators.

CO5. Evaluate and integrate methods into applications such as PCA, SVMs, and neural networks with appropriate regularization.

SYLLABUS:

UNIT-I: LINEAR ALGEBRA FOUNDATIONS (09 Periods)

Vector spaces, norms, inner products, orthogonality, and projections; Eigenvalues/eigenvectors, spectral theorem, and invariant subspaces; Singular value decomposition, low- rank approximations, and Eckart–Young; Matrix calculus for ML; gradients/Jacobians/Hessians in matrix form; Numerical linear algebra: conditioning, stability, power/QR methods; Feature whitening and centering; PCA link to covariance eigen structure.

UNIT-II: OPTIMIZATION FOR LEARNING (08 Periods)

Unconstrained methods: gradient descent, line search, Newton/quasi- Newton; Constrained optimization: Lagrange multipliers, projected and barrier methods; Convex sets/functions, KKT conditions for nonlinear programing problems; Regularization: l_1/l_2penalties, bias–variance trade-offs in risk minimization; Convergence rates and step- size strategies in deterministic models.

UNIT-III: PROBABILITY AND STATISTICAL LEARNING (10 Periods)

Random variables, expectations, covariance; exponential family basics; Bayesian inference: conjugacy, MAP vs. MLE, posterior predictive analysis; Hypothesis testing and confidence intervals for model comparison; Information measures: entropy, KL divergence, mutual information in learning; Generalization, overfitting, and model selection criteria (e.g., AIC/BIC/VC-style capacity); Concentration and uncertainty quantification for predictions.

UNIT-IV: MODELS AND ALGORITHMS (09 Periods)

Linear and kernel methods: least squares, logistic regression, and SVMs; Dimensionality reduction: PCA, kernel PCA, and manifold intuition; Probabilistic models: Naive Bayes, Gaussian mixtures, EM overview; Neural network mathematics: backpropagation, initialization, normalization; Regularization schemes: weight decay, early stopping, dropout perspectives.

UNIT-V: INTEGRATIVE APPLICATIONS AND WORKED EXAMPLES (09 Periods)

End-to-end ML pipelines: preprocessing, scaling/whitening, and feature engineering; PCA- based exploration and anomaly detection in high- dimensional data; SVMs and convex models for fault diagnosis and predictive maintenance; Bayesian A/B testing and decision- making under uncertainty; Neural network design trade-offs: capacity, optimization, and generalization; Model evaluation: calibration, ROC/PR analysis, and uncertainty reporting.

Total Periods: 45

Text Books:

T1. Mathematics for Machine Learning. Deisenroth, M. P., Faisal, A. A., & Ong, C. S. Cambridge University Press, 2020

T2. Probabilistic Machine Learning: An Introduction, Murphy, K. P., MIT Press, 2022.

T3. Convex Optimization, Boyd, S., & Vandenberghe, L., Cambridge University Press, 2004.

Reference Books:

R1. Deep Learning, Goodfellow, I., Bengio, Y., & Courville, A., MIT Press, 2016

R2. Understanding Machine Learning: From Theory to Algorithms. Shalev- Shwartz, S., & Ben-David, S., Cambridge University Press, 2014

R3. Principal component analysis: a review and recent developments. Jolliffe, I. T., & Cadima, J., Phil. Trans. R. Soc. A, 2016

R4. Elements of Information Theory, Cover, T. M., & Thomas, J. A. 2nd ed. Wiley, 2006.

R5. Probabilistic Machine Learning: Advanced Topic, Murphy, K. P. MIT Press, 2023.

		L	T	P	C
25HS383	**M.Tech., III-SEMESTER** **STATISTICAL LEARNING THEORY AND MATHEMATICAL FOUNDATIONS OF AI** (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) **(OPEN ELECTIVE)**	**3**	**0**	**0**	**3**

Pre-Requisites: NIL

Course Outcomes:

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

- **CO1.** Analyze probabilistic models, convergence theorems, and stochastic processes underlying learning algorithms.
- **CO2.** Formulate and prove generalization bounds using VC dimension, Rademacher complexity, and stability.
- **CO3.** Derive and optimize loss/regularization for linear, kernel, and deep models; justify selections by convexity and smoothness properties.
- **CO4.** Evaluate algorithms via bias–variance, PAC guarantees, and information- theoretic criteria such as KL and mutual information.
- **CO5.** Integrate theory to design robust AI solutions for multi- domain engineering applications and communicate findings effectively.

SYLLABUS:

UNIT-I: PROBABILITY AND MEASURE FOUNDATIONS (09 Periods)

Probability spaces, σ- algebras, random variables; expectation and conditional expectation; Inequalities and concentration: Markov, Chebyshev, Hoeffding; LLN and CLT; Modes of convergence and Borel–Cantelli; almost sure vs in- probability convergence; Random processes and martingale basics; optional stopping; Doob's inequality (overview); Markov chains: ergodicity, mixing, stationary distributions for modeling sequences.

UNIT-II: STATISTICAL LEARNING THEORY (09 Periods)

PAC learning model, realizable/agnostic cases; sample complexity and no- free- lunch; VC dimension, shattering, Sauer's lemma; uniform convergence guarantees; Empirical risk minimization and structural risk minimization; capacity control; Rademacher/Gaussian complexities and symmetrization for data- dependent bounds; Algorithmic stability and generalization; regularization and early stopping as capacity control; PAC- Bayes bounds and posterior- based generalization certificates.

UNIT-III: OPTIMIZATION FOR LEARNING (09 Periods)

Convex analysis: Lipschitzness, smoothness, strong convexity; implications for rates; Gradient, stochastic, and variance- reducedethods; step- size and convergence trade-offs; Proximal methods and projected gradients; sparsity via ℓ_1 (Lasso) and shrinkage via ℓ_2 (ridge); Duality and KKT conditions; constrained learning formulations; Nonconvex landscapes in deep networks—saddle points, over-parameterization, and implicit regularization; Generalization–optimization interplay: implicit bias of optimizers.

UNIT-IV: KERNEL AND PROBABILISTIC MODELS (09 Periods)

Reproducing kernel Hilbert spaces, kernel trick, representer theorem; Large- margin methods: SVMs, soft margins, hinge loss; primal–dual views; Gaussian processes: kernels as priors; posterior prediction and uncertainty quantification; Graphical models—Bayesian networks and

Markov/conditional random fields for structured prediction; exact inference (variable elimination, junction tree) and approximate methods (loopy belief propagation, variational); Hidden Markov models; EM for latent- variable learning; Variational inference and message passing for scalable probabilistic AI.

UNIT-V: DEEP LEARNING AND INFORMATION THEORY (09 Periods)

Backpropagation (chain rule), initialization, normalization, and activation design; Loss functions and calibration; cross- entropy, margin losses, and robust objectives; Generalization in deep nets: margins, flat minima, compression, and stability views; Information- theoretic tools: entropy, mutual information, KL divergence; Information bottleneck and representation learning, with links to PAC- Bayes; Worked examples: applying theory to vision, language, and control tasks in engineering.

Total Periods: 45

Text Books:

T1. Understanding Machine Learning: From Theory to Algorithms, Shalev- Shwartz, S., Ben-David, S., Cambridge University Press, first edition, 2014.

T2. Deep Learning, Goodfellow, I., Bengio, Y., Courville, A., MIT Press, 2016.

T3. Pattern Recognition and Machine Learning, Bishop, C. M., Springer, 2006.

Reference Books:

R1. The Nature of Statistical Learning Theory, Vapnik, V. N., Springer, 1995/1998.

R2. Elements of Information Theory, Cover, T. M., Thomas, J. A., 2nd ed., Wiley, 2006.

R3. Foundations of Machine Learning, Mohri, M., Rostamizadeh, A., Talwalkar, A., 2nd ed., MIT Press, 2018.

R4. Learning with Kernels: Support Vector Machines, Regularization, Optimization, and Beyond, Schölkopf, B., Smola, A. J., MIT Press, 2002.

R5. Gaussian Processes for Machine Learning, Rasmussen, C. E., Williams, C. K. I., MIT Press, 2006.

25HS384	M.Tech., III-SEMESTER CHEMISTRY OF NANOMATERIALS AND APPLICATIONS IN ENGINEERING (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) (OPEN ELECTIVE)	L	T	P	C
		3	0	0	3

Pre-Requisites: NIL

COURSE OUTCOMES:

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

CO1. Explain the basic concepts, scope, natural occurrence, classification, and importance of nanoscience and nanomaterials**.**

CO2. Explain the top-down and bottom-up synthetic methods used for the preparation of nanomaterials**.**

CO3. Understand the principles and applications of various characterization techniques used for analyzing nanomaterials**.**

CO4. Explain the synthesis, properties, and applications of important nanomaterials**.**

CO5. Understand the applications of nanomaterials such as nanoparticles, nanorods, and nanowires in various engineering and technological fields**.**

SYLLABUS:

UNIT-I: BASICS OF NANOMATERIALS (08 Periods)

Introduction**,** Scope of nanoscience and nanotechnology, nanoscience in nature, classification of nanostructured materials, importance of nanomaterials.

UNIT-II: SYNTHESIS OF NANOMATERIALS (10 Periods)

Top-Down approach**,** Inert gas condensation, arc discharge method, aerosol synthesis, plasma arc technique, ion sputtering, laser ablation, laser pyrolysis, and chemical vapor deposition method, electrode position method, high-energy ball milling method.

Synthetic Methods**:** Bottom-Up approach**,** Sol-gel synthesis, microemulsions or reverse micelles, co- precipitation method, solvothermal synthesis, hydrothermal synthesis, microwave heating synthesis and sonochemical synthesis.

UNIT-III: TECHNIQUES FOR CHARACTERIZATION (09 Periods)

Diffraction techniques, spectroscopy techniques, electron microscopy techniques for the characterization of nanomaterials, BET method for surface area analysis, dynamic light scattering for particle size determination.

UNIT-IV: STUDIES OF NANO-STRUCTURED MATERIALS (09 Periods)

Synthesis, properties and applications of the following nanomaterials: fullerenes, carbon nanotubes, 2D-nanomaterial (Graphene), core-shell, magnetic nanoparticles, thermoelectric materials, non-linear optical materials.

UNIT-V: ADVANCED ENGINEERING APPLICATIONS OF NANOMATERIALS (09 Periods)

Applications of nanoparticles, nanorods, nano wires in Water treatment, sensors, electronic devices, medical domain, civil engineering, chemical engineering, metallurgy and mechanical engineering, food science, agriculture, pollutants degradation.

Total Periods: 45

Text Books:

T1. NANO: The Essentials, T Pradeep, MaGraw-Hill, 2007.

T2. Textbook of Nanoscience and nanotechnology, B S Murty, P Shankar, Baldev Rai,BB Rath and James Murday, Univ. Press, 2012.

Reference Books:

R1. Concepts of Nano chemistry; LudovicoCademrtiri and Geoffrey A. Ozin & Geoffrey A. Ozin, Wiley-VCH, 2011.

R2. Nanostructures & Nanomaterials; Synthesis, Properties & Applications, Guozhong Cao, Imperial College Press, 2007.

R3. Nanomaterials Chemistry, C. N. R. Rao, Achim Muller, K.Cheetham, Wiley-VCH, 2007.

25HS385	M.Tech., III-SEMESTER PHOTONICS FOR ENGINEERS (Common to AIDS, PS, Geo-Tech, RE, ES&VLSI) (OPEN ELECTIVE)	L	T	P	C
		3	0	0	3

Pre-Requisites: NIL

Course Outcomes:

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

CO1. Describe how light behaves and propagates in optical media.

CO2. Explain light–matter interaction mechanisms and analyze the working, characteristics, and applications of LEDs, laser diodes, quantum well lasers and various photodetectors.

CO3. Explain key nonlinear effects and analyze the operation of optical modulators and switches such as the Mach–Zehnder Interferometer.

CO4. Analyse fiber parameters and explain the functioning of transmitters, receivers, WDM systems, couplers and resonator-based communication devices.

CO5. Describe the working of photonic sensors and emerging quantum and ultrafast photonic technologies used in sensing, computation and communication.

SYLLABUS:

UNIT-I: FUNDAMENTALS OF PHOTONICS (09 Periods)

Nature of light: wave-particle duality, polarization, coherence. Maxwell's equations and wave propagation in dielectric media. Reflection, refraction, (vector notation) interference, diffraction, dispersion and birefringence.

UNIT-II: PHOTONIC DEVICES AND COMPONENTS – I (09 Periods)

Absorption, spontaneous and stimulated emission. Einstein coefficients, population inversion, optical gain. Semiconductor light sources: LEDs, laser diodes, quantum well lasers. Photodetectors: PIN, avalanche photodiodes, photomultiplier tubes.

UNIT-III: PHOTONIC DEVICES AND COMPONENTS – II (09 Periods)

Nonlinear optical effects – second-harmonic generation, Kerr effect, four-wave mixing. Electro-optic Magneto optic and acousto-optic modulation principles. Optical modulators and switches (Mach Zehnder Interferometer).

UNIT-IV: OPTICAL WAVEGUIDES AND APPLICATIONS (09 Periods)

Optical fibers – numerical aperture, V-number, modes, attenuation, dispersion. Fiber-optic communication systems: transmitters, receivers, multiplexing (WDM), optical couplers, ring resonators.

UNIT-V: PHOTONIC SYSTEMS AND APPLICATIONS (09 Periods)

Photonic sensors – interferometric, fiber Bragg gratings, biosensing. Optical signal processing and computing.

Introduction to quantum photonics: single-photon sources, entanglement, and photonic qubits. Plasmonics and metamaterials, Ultrafast and terahertz photonics.

Total Periods: 45

Text Books:

T1. Fundamentals of Photonics, B.E.A. Saleh & M.C. Teich., Wiley.

T2. Semiconductor Optoelectronics: Physics and Technology, J. Singh, McGraw Hill Edition.

T3. Photonics: Optical Electronics in Modern Communications, A. Yariv & P. Yeh, Oxford Series.

T4. Optical Fiber Communications, G. Keiser, McGraw Hill Edition.

Reference Books:

R1. Optoelectronics: An Introduction, J. Wilson & J.F.B. Hawkes.
R2. Nonlinear Optics, R.W. Boyd.
R3. Electromagnetic waves and radiating systems E. Jordan.

2584451	M.Tech., IV-SEMESTER DISSERTATION PHASE–II (EMBEDDED SYSTEMS AND VLSI)	L	T	P	C
		0	0	32	16

Pre-Requisites: All Courses

Course Outcomes:

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

CO1. Implement the proposed methodology or design to develop a functional solution or prototype for the identified research problem.

CO2. Analyze and evaluate the results using appropriate tools, techniques, or experimental methods.

CO3. Interpret results and draw meaningful conclusions with respect to the objectives of the research work.

CO4. Prepare a comprehensive project report and effectively present the research findings through seminars and viva voce.

CO5. make decisions to manage tasks and also engage in independent and life-long learning with ability to adapt to new and technological changes.

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