JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
Draft Academic Regulations of M.Tech. (Full Time/Regular) Programme
(Effective for the students admitted into I year from the Academic Year 2021-22 and onwards)

Jawaharlal Nehru Technological University Anantapur (JNTUA) 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 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 70 credits and secures all 70 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 in non-autonomous affiliated colleges:

S.No.	Discipline	Name of the Specialization	Code
01	Civil Engineering	Structural Engineering	20
		Geotechnical Engineering	12
		Computer Aided Structural Engineering	35
		Construction Planning &Management	21
		Structural Engineering &Construction Management	91
		Highway Engineering	93
02	Electrical and Electronics Engineering	Electrical Power Systems	07
		Power Electronics	43
		Power Electronics & Electrical Drives	54
		Power Systems	82
03	Mechanical Engineering	CAD / CAM	04
		Machine Design	15
		Thermal Science & Energy Systems	11
		Refrigeration & Air- Conditioning	17
		Advanced Manufacturing Systems	87

		Thermal Engineering	88
		Production Engineering &Engineering Design	90
		Production Engineering	94
04	Electronics and Communication Engineering	Digital Electronics & Communication Systems	38
		Electronics & Communication Engineering	70
		Digital Systems & Computer Electronics	06
		Embedded Systems	55
		VLSI Design	57
		VLSI System Design	
		VLSI	
		VLSI & Embedded Systems	68
		Embedded Systems & VLSI	
		VLSI and Embedded Systems Design	85
05	Computer Science and Engineering	Computer Science & Engineering	58
		Software Engineering	25
		Computer Networks	08
		Artificial Intelligence & Machine Learning	98

and any other specializations as approved by AICTE/University from time to time.

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
2.	Elective Courses	Professional Elective Courses (PE)	Includes elective subjects related to the parent discipline/department/ branch of Engineering
		Open Elective Courses (OE)	Elective subjects which include inter-disciplinary subjects or subjects in an area outside the parent discipline which are of importance in the context of special skill development
3.	Research	Research methodology & IPR	To understand importance and process of creation of patents through research
		Technical Seminar	Ensures preparedness of students to undertake major projects/Dissertation, based on core contents related to specialization
		Cocurricular Activities	Attending conferences, scientific presentations and other scholarly activities
		Dissertation	M.Tech. Project or Major Project
4.	Audit Courses	Mandatory noncredit courses	Covering subjects of developing desired attitude among the learners is on the line of initiatives such as Unnat Bharat Abhiyan, Yoga, Value education etc.

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 University external 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 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 subject - wise (irrespective of credits assigned), for a maximum of 100 marks for theory and 100 marks for practical, based on Internal Evaluation and End Semester Examination.

8.1 There shall be five units in each of the theory subjects. For the theory subjects 60 marks will be for the 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. 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) each question for 10 marks. Final Internal marks for a total of 30 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. There shall be an online examination (TWO) conducted during the respective mid examinations by the college for the remaining 10 marks with 20 objective questions.

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 bits.

8.4 For practical subjects, 60 marks shall be for the End Semester 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 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 a **Technical Seminar** during I year II semester for internal evaluation of 100 marks. A student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Project Review Committee consisting of Head of the Department, supervisor/mentor and two other faculty members of the department. The student has to secure a minimum of 50% of marks, to be declared successful. If he fails to obtain the minimum marks, he has to reappear for the same as and when supplementary examinations are conducted. The Technical seminar shall be conducted anytime during the semester as per the convenience of the Project Review Committee and students. There shall be no external examination for Technical Seminar.

8.6 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 every six months/semester satisfying the conditions mentioned in item 1 & 2 of the regulations.

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

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

8.9 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, the University shall allow up to a maximum of 40% of the total courses being offered in a particular Programme in a semester through the Online Learning courses through SWAYAM.

9.1 The University shall offer 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 institution, it is mandatory for the student to share necessary information with the institution

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

9.6 The institution shall also ensure that the student has to complete the course and produce the course completion certificate as per the academic schedule given for the regular courses in that semester

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

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

9.9 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 percentage of marks and grades.

9.10 The institution shall submit the following to the examination section of 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.

9.11 The university shall 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 shall 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 University 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 subject 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 subjects for which the Internal Evaluation marks secured are more than 50%.

10.3 Out of the subjects 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 subject and for a maximum of **three** Theory subjects for Improvement of Internal evaluation marks.

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

10.5 For reregistration the candidates have to apply to the University through the college by paying the requisite fees and get approval from the University 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 End Examinations marks secured in the previous attempt(s) for the reregistered subjects 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. Internal evaluation of the Project Work – I & Project work – II in III & IV semesters respectively shall be for 100 marks each. 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 requirement in all the subjects, 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.

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

11.5 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.

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

11.7 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.

11.8 After registration, a candidate must present in Project Work 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. Only after obtaining the approval of the PRC can the student initiate the project work.

11.9 The Project Work 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.

11.10 A candidate has to secure a minimum of 50% of marks to be declared successful in Project Work Review - II. Only after successful completion of Project Work Review – II, candidate shall be permitted for Project Work Review – III in IV Semester. The unsuccessful students in Project Work Review - II shall reappear for it as and when supplementary examinations are conducted.

11.11 The Project Work 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 Work Review - III. If he fails to obtain the required minimum marks, he has to reappear for Project Work Review - III after a month.

11.12 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.

11.13 After approval from the PRC, the students are required to submit a report showing that the plagiarism is within 30%. The dissertation report will be accepted only when the plagiarism is within 30%, which shall be submitted along with the dissertation report.

11.14 Research paper related to the Project Work shall be published in conference proceedings/UGC recognized journal. A copy of the published research paper shall be attached to the dissertation.

11.15 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.

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

11.17 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 University

11.18 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.

11.19 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.

11.20 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. Credits for Co-curricular Activities

The credits assigned for co-curricular activities shall be given by the principals of the colleges and the same shall be submitted to the University.

A Student shall earn 02 credits under the head of co-curricular activities, viz., attending Conference, Scientific Presentations and Other Scholarly Activities.

Following are the guidelines for awarding Credits for Co-curricular Activities

Name of the Activity	Maximum Credits / Activity
Participation in National Level Seminar/ Conference / Workshop /Training programs (related to the specialization of the student)	1
Participation in International Level Seminar / Conference / workshop/Training programs held outside India (related to the specialization of the student)	2
Academic Award/Research Award from State Level/National Agencies	1
Academic Award/Research Award from International Agencies	2
Research / Review Publication in National Journals (Indexed in Scopus / Web of Science)	1
Research / Review Publication in International Journals with Editorial board outside India (Indexed in Scopus / Web of Science)	2

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.

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

13. 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 subject fall	Grade	Grade points Assigned
≥ 90	S (Superior)	10
$\geq 80 < 90$	A (Excellent)	9
$\geq 70 < 80$	B (Very Good)	8
$\geq 60 < 70$	C (Good)	7
$\geq 50 < 60$	D (Pass)	6
< 50	F (Fail)	0
Absent	Ab (Absent)	0

i) A student obtaining Grade 'F' or Grade 'Ab' in a subject shall be considered failed and will be required to reappear for that subject 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} subject 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.,

$$CGPA = \Sigma (C_i \times S_i)/ \Sigma C_i$$

where "S_i" is the SGPA of the i^{th} semester and C_i 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 subjects 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.

14. 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	Percentage of Marks to be secured
First Class with Distinction	≥70%
First Class	< 70% ≥ 60%
Pass Class	< 60% ≥ 50%

15. **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 University 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.

16. Withholding of Results:

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

17. **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 subjects as and when subjects are offered, subject to Section 2 and they will follow the academic regulations into which they are readmitted.

18. General:

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

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

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

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

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

17.6 The University 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 University.

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RULES FOR

DISCIPLINARY ACTION FOR MALPRACTICES / IMPROPER CONDUCT IN EXAMINATIONS

	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 subject 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 subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other 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 subject 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 subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The Hall Ticket of the 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 subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for four consecutive semesters from class work and all University examinations if his 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 subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The 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 subject 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 of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects 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.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The 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 subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The 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 subject and all other subjects the candidate has already appeared including practical examinations and project

		work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The 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 subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject only or in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester / year 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 subject/subjects due to Malpractice, he has to register for End Examinations in that subject/subjects consequently and has to fulfil all the norms required for the award of Degree.

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M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

SEMESTER – I

S. No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D35101	Theory of Elasticity	PC	3	0	0	3
2.	21D20101	Advanced Structural Analysis	PC	3	0	0	3
3.	21D35203b 21D21102a 21DBS105	**Program Elective - I** Theory and Analysis of Plates and Shells Advanced Concrete Technology Advanced Mathematical Methods	PE	3	0	0	3
4.	21D35104b 21D20103a 21D20103b	**Program Elective – II** Design of Prestressed Concrete Maintenance and Rehabilitation of Structures Design of Bridges	PE	3	0	0	3
5.	21D35206	Advanced Concrete Laboratory	PC	0	0	4	2
6.	21D35106	Advanced Structural Engineering Laboratory	PC	0	0	4	2
7.	21DRM101	Research Methodology and IPR	MC	2	0	0	2
8.	21DAC101a 21DAC101b 21DAC101c	**Audit Course – I** English for Research paper writing Disaster Management Sanskrit for Technical Knowledge	AC	2	0	0	0
Total							**18**

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SEMESTER – II

S.No.	Course codes	Course Name	Category	Hours per week L	T	P	Credits
1.	21D35201	Structural Dynamics	PC	3	0	0	3
2.	21D20201	Finite Element Methods for Structural Engineering	PC	3	0	0	3
3.	21D20202a 21D20202b 21D20202c	**Program Elective – III** Design of Reinforced Concrete Foundations Experimental Stress Analysis Stability of Structures	PE	3	0	0	3
4.	21D20203a 21D20203b 21D20203c	**Program Elective – IV** Advanced Steel Design Fracture Mechanics Advanced Reinforced Concrete Design	PE	3	0	0	3
5.	21D20204	Computer Aided Design Laboratory	PC	0	0	4	2
6.	21D20205	Advanced Structural Design Laboratory	PC	0	0	4	2
7.	21D20206	Technical seminar	PR	0	0	4	2
8.	21DAC201a 21DAC201b 21DAC201c	**Audit Course – II** Pedagogy Studies Stress Management for Yoga Personality Development through Life Enlightenment Skills	AC	2	0	0	0
Total							**18**

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SEMSTER - III

S.No.	Course codes	Course Name	Category	Hours per L	T	P	Credits
1.	 21D35301a 21D20301a 21D20301b	**Program Elective – V** Earthquake Resistant Design of Buildings Low-Cost Housing Techniques Building Construction Management	PE	3	0	0	3
2.	 21DOE301a 21DOE301b 21DOE301c	**Open Elective** Cost Management of Engineering Project Industrial Safety Business Analytics	OE	3	0	0	3
3.	21D20302	Dissertation Phase – I	PR	0	0	20	10
4.	21D203013	Co-curricular Activities					2
Total							**18**

SEMESTER - IV

S.No.	Course codes	Course Name	Category	Hours per L	T	P	Credits
1.	21D20401	Dissertation Phase – II	PR	0	0	32	16
Total							**16**

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M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	THEORY of ELASTICITY	L	T	P	C
21D35101		3	0	0	3
	Semester	I			

Course Objectives: This Course Will Enable Students:

- To make students understand the principles of elasticity.
- To familiarize students with basic equations of elasticity.
- To expose students to two dimensional problems in Cartesian and polar coordinates.
- 4. To make students understand the principle of torsion of prismatic bars.

Course Outcomes (CO): Student will be able to

- To apply elastic analysis to study the fracture mechanics.
- To apply linear elasticity in the design and analysis of structures such as beams, plates, shells and sandwich composites.
- To apply hyper elasticity to determine the response of elastomer-based objects.
- To analyze the structural sections subjected to torsion.

UNIT - I Lecture Hrs:10

INTRODUCTION TO PLANE STRESS and PLANE STRAIN ANALYSIS:
Elasticity –Notation for Forces and Stresses-Components of Stresses –Components of Strain – Hooke's Law. Plane Stress-Plane Strain-Differential Equations of Equilibrium- Boundary Conditions- Compatibility Equations-Stress Function-Boundary Conditions.

UNIT - II Lecture Hrs:10

TWO DIMENSIONAL PROBLEMS in RECTANGULAR COORDINATES:
Solution by Polynomials-Saint Venant's Principle-Determination of Displacements-Bending of Simple Beams-Application of Fourier Series for Two Dimensional Problems - Gravity Loading.

UNIT - III Lecture Hrs:10

TWO DIMENSIONAL PROBLEMS in POLAR COORDINATES :
General Equation in Polar Co-Ordinates - Stress Distribution Symmetrical About An Axis –Pure Bending of Curved Bars- Strain Components in Polar Coordinates-Displacements for Symmetrical Stress Distributions-Simple Symmetric and Asymmetric Problems-General Solution of Two Dimensional Problem in Polar Coordinates-Application of The General Solution of Two Dimensional Problem in Polar Coordinates-Application of The General Solution in Polar Coordinates.

UNIT - IV Lecture Hrs:9

ANALYSIS of STRESS and STRAIN in THREE DIMENSIONS: Principle Stress - Ellipsoid and Stress-Director Surface-Determination of Principle Stresses- Maximum Shear Stresses-Homogeneous Deformation-Principle Axis of Strain Rotation.
General Theorems: Balance Laws - Differential Equations of Equilibrium- Conditions of Compatibility - Determination of Displacement-Equations of Equilibrium in Terms of Displacements-Principle of Superposition-Uniqueness of Solution –The Reciprocal Theorem.

UNIT - V Lecture Hrs:9

TORSION of PRISMATIC BARS:
Torsion of Prismatic Bars- Elliptical Cross Section-Other Elementary Solutions-Membrane Analogy-Torsion of Rectangular Bars-Solution of Torsional Problems by Energy Method-Use of Soap Films in Solving Torsional Problems-Hydra Dynamical Analogies-Torsion of Shafts, Tubes and Bars.

Textbooks:

1. Theory of Elasticity and Plasticity by Timoshenko, S., MC Graw Hill Book company.
2. Advanced Strength of materials by Papoov, MC Graw Hill Book company.
3. Theory of Elasticity and Plasticity by Sadhu Singh. Khanna Publishers.

Reference Books:

1. Plasticity for structural Engineers- Chen, W.F. and Han, D.J., Springer – Verlag, New York.
2. Plasticity theory, Lubliner, J., Mac Millan Publishing Co., New York.
3. Foundations of Solid Mechanics by Y.C.Fung, PHI Publications.
4. Advanced Mechanics of Solids by L.S. Srinath, Tata MC Graw Hill Book company.

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M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED STRUCTURAL ANALYSIS	L	T	P	C
21D20101		3	0	0	3
	Semester	I			

Course Objectives: This Course Will Enable Students:

- To understand the static and kinematic indeterminacy of the structures
- To understand the concepts of matrix methods of analysis of structures
- To understand the analysis of continuous beams.
- To understand the analysis of rigid and pin jointed frames

Course Outcomes (CO): Student will be able to

- Distinguish determinate and indeterminate structures.
- Identify the method of analysis for indeterminate structures.
- Apply matrix methods of analysis for continuous beams.
- Apply matrix methods of analysis for rigid and pin jointed frames.

UNIT - I Lecture Hrs:

Introduction to matrix methods of analysis - statical indeterminacy and kinematical indeterminacy - degree of freedom - coordinate system - structure idealization stiffness and flexibility matrices - suitability element stiffness equations - elements flexibility equations - mixed force - displacement equations - for truss element, beam element and torsional element.
Transformation of coordinates - element stiffness matrix - and load vector - local and global coordinates.

UNIT - II Lecture Hrs:

Assembly of stiffness matrix from element stiffness matrix - direct stiffness method - general procedure - banded matrix - semi bandwidth - assembly by direct stiffness matrix method.

UNIT - III Lecture Hrs:

Analysis of plane truss - continuous beams with and without settlement - plane frame including side sway single storey, single – bay and gable frame by flexibility method using system approach.

UNIT - IV Lecture Hrs:

Analysis of plane truss - continuous beams with and without settlement - plane frame including sides sway, grids and gable frames by stiffness methods, single bay – two storey, two bay single – storey.

UNIT - V Lecture Hrs:

Special analysis procedures - static condensation and sub structuring - initial and thermal stresses.

Textbooks:

1. Matrix Analysis of Frames structures by William Weaver J.R and James M.Gere, CBS publications.
2. Advanced Structural Analysis by Ashok.K.Jain, New Channel Brothers.
3. Matrix method of S.A by Pandit & Gupta

Reference Books:

1. Matrix Structural Analysis by Madhu B. Kanchi.
2. Matrix Methods of Structural Analysis by J.Meek.
3. Structural Analysis by Ghali and Neyveli.
4. Structural Analysis by Devdas Menon, Narosa Publishing Housing Pvt Ltd.

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COURSE STRUCTURE & SYLLABI

Course Code	THEORY and ANALYSIS of PLATES and SHELLS (PE-I)	L	T	P	C
21D35203b		3	0	0	3
	Semester	I			

Course Objectives: This Course Will Enable Students:

- Introduce with concept of plate theory,the behaviour and analysis
- Knowledge about classification of shell surfaces
- To analyse the plate with different boundary conditions
- To understand the classical theory oh shells based on the kirchoff-love assumptions.

Course Outcomes (CO): Student will be able to

- Assess the strength of plate panels under point,linearly varying and uniformly distributed loads
- Analyze plates under different boundary conditions by various classical methods and approximated methods
- Familiar with classification of shells and classical shell theories and apply them in engineering design
- Exposed to single curved shells, doubly curves shells and cylindrical shells

UNIT - I — Lecture Hrs:10

Introduction: Space Curves, Surfaces, Shell Co-ordinates, Strain Displacement Relations, Assumptions in Shell Theory, Displacement Field Approximations, Stress Resultants, Equation of Equilibrium using Principle of Virtual Work, Boundary Conditions.

UNIT - II — Lecture Hrs:10

Small Deflection Theory of Thin Rectangular Plates : Assumptions – Derivation of governing differential equation for thin plates – Boundary conditions – simply supported plate under sinusoidal load – Navier solution – Application to different cases – Levy's solution for various boundary conditions subjected to different loadings like uniform and hydrostatic pressure.

UNIT - III — Lecture Hrs:10

Circular Plates: Differential Equation for symmetrical bending of Laterally loaded circular Plates – Uniformly loaded circular plates –circular plate concentrically loaded – circular plate loaded at center

UNIT - IV — Lecture Hrs:9

Shells – functional behaviour – examples – structural behaviour of shells classification of shells – Definitions – various methods of analysis of shells – merits and demerits of each method – 2D. Membrane equation.

Equations of equilibrium: Derivation of stress resultants – cylindrical shells – Flugges simulations equations.

UNIT - V — Lecture Hrs:9

Introduction to the shells of Double curvatures:_ Geometry, analysis and design of elliptic paraboloid, conoid and hyperbolic parabolic shapes, inverted umbrella type.

Axi- Symmetrical shells: General equation - Analysis and axi-symmetrical by membrane theory. Application to spherical shell and hyperboloid of revolution cooling towers.

Textbooks:

1. Theory of Plates & Shells –Stephen, P.Timoshenko, S.Woinowsky-Krieger – Tata MC Graw Hill Edition
2. Analysis and design of concrete shell roofs by G.S.Ramaswami. CBS publications.
3. Design of concrete shell roofs by Billington – Tata MC Graw Hill, New York

Reference Books:

1. Shell Analysis by N.K.Bairagi. Khanna Publishers, New Delhi.
2. Design of Shells and Folded Plates by P.C. Varghese, PHI Learning Pvt. Ltd
3. Design of concrete shell roofs by Chaterjee. Oxford and IBH.,

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M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED CONCRETE TECHNOLOGY (PE-I)	L	T	P	C
21D21102a		3	0	0	3
	Semester	I			

Course Objectives: This Course Will Enable Students:

- To study the properties of concrete making materials
- To do mix design
- Famiiar with the methods of concrete
- Knowledge about advance tests on concrete

Course Outcomes (CO): Student will be able to

- To be familiar with the properties of concrete making materials
- Identify the influence and compatibility of chemcial,mineral admixtures in concrete
- Update the knowledge on recent advances in special concretes.
- Know about various methods of concrete
- Analyse the performance of concrete structure through microstructure analysis

UNIT - I — Lecture Hrs:10

Cements and Admixtures: Portland Cement – Chemical Composition - Hydration, Setting and Finenesses of Cement – Structures of Hydrated Cement – Mechanical Strength of Cement Gel - Water Held in Hydrate Cement Paste – Heat of Hydration of Cement – Influence of Compound Composition on Properties of Cement – Tests on Physical Properties of Cement – I.S. Specifications – Different Types of Cements – Admixtures.

UNIT - II — Lecture Hrs:10

Aggregates: Classification of Aggregate – Particle Shape and Texture – Bond Strength and Other Mechanical Properties of Aggregate Specific Gravity, Bulk Density, Porosity, Absorption and Moisture in Aggregate – Soundness of Aggregate – Alkali – Aggregate Reaction, Thermal Properties – Sieve Analysis – Fineness Modulus – Grading Curves – Grading Requirements – Practical Grading – Road Note No.4 Grading of Fine and Coarse Aggregates Gap Graded Aggregate – Maximum Aggregate Size.

UNIT - III — Lecture Hrs:10

Fresh Concrete: Workability – Factors Affecting Workability – Measurement of Workability by Different Tests – Effect of Time and Temperature on Workability – Segregation and Bleeding – Mixing and Vibration of Concrete – Quality of Mixing Water.

Hardened Concrete: Water/Cement Ratio-Abram's Law – Gel Space Ratio – Effective Water in Mix – Nature of Strength of Concrete – Strength in Tension and Compression- Griffith's Hypothesis – Factors Affecting Strength – Autogeneous Healing –Relation Between Compression and Tensile Strength – Curing and Maturity of Concrete Influence of Temperature on Strength – Steam Curing – Testing of Hardened Concrete – Compression Tests – Tension Tests – Factors Affecting Strength – Flexure Tests – Splitting Tests – Non Destructive Testing Methods.

UNIT - IV — Lecture Hrs:9

Elasticity, Shrinkage and Creep: Modulus of Elasticity – Dynamic Modulus of Elasticity – Poisson's Ratio – Early Volume Changes – Swelling – Draying Shrinkage - Mechanism of Shrinkage – Factors Affecting Shrinkage – Differential Shrinkage – Moisture Movement Carbonation Shrinkage-Creep of Concrete – Factors Influencing Creep – Relation Between Creep and Time – Nature of Creep – Effect of Creep.

UNIT - V — Lecture Hrs:9

Mix Design: Proportioning of Concrete Mixes by Various Methods – Fineness Modulus, Trial and Error, Mix Density, Road Note. No. 4, ACI and ISI Code Methods – Factors in The Choice of Mix Proportions – Durability of Concrete – Quality Control of Concrete – Statistical Methods – High Strength Concrete Mix Design.

Special Concretes: Light Weight Concretes –Light Weight Aggregate Concrete- Cellular Concrete - No Fines Concrete – High Density Concrete – Fiber Reinforced Concrete – Different Types of Fibers - Factories Affecting Properties of FRC – Applications Polymer Concrete – Types of Polymer

Concrete Properties of Polymer Concrete and Applications
Textbooks:
1. Properties of Concrete by A.M.Neville – Pearson Publication – 4th Edition 2. Concrete Technology by M.S.Shetty. – S.Chand & Co. ; 2004 3. Concrete Technology by A.R. Santha Kumar, Oxford University Press, New Delhi
Reference Books:
1. Concrete: Micro Structure, Properties and Materials – P.K.Mehta and J.M.Monteiro, Mc-Graw Hill Publishers 2. Design of Concrete Mix by Krishna Raju, CBS Pubilishers. 3. Concrete Technology by A.M.Neville – Pearson Publication 4. Concrete Technology by M.L. Gambhir. – Tata Mc. Graw Hill Publishers, New Delhi 5. Non-Destructive Test and Evaluation of Materials by J.Prasad & C.G.K. Nair , Tata Mcgraw Hill Publishers, New Delhi

M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED MATHEMATICAL METHODS	L	T	P	C
21DBS105	Common to (SE and CM and SE (PEC-I))	3	0	0	3
	Semester	I			

Course Objectives: This Course Will Enable Students:

- With calculus of variation, numerical methods of solving ordinary and partial differential equations.
- To impart knowledge in basic concepts of finite element methods and applications.

Course Outcomes (CO): Student will be able to

- Solve functionals using Hamilton's principle .
- Numerically solve ordinary and partial differential equations that are initial value or boundary value problems.
- Apply the concepts of finite element method for 1-D and 2-D problems.

UNIT - I	Calculus of Variation	Lecture Hrs: 8

Calculus of Variation – Functionals – Euler's Equation - Solution of Euler's Equation – Isoperimetric problems – several dependent variables – Functionals involving higher Order derivatives – Hamilton's principle – Lagrange's Equations.

UNIT - II	Numerical Solution of ordinary Differential Equations & Eigen values and Eigen vectors	Lecture Hrs: 8

Numerical Methods: Eigen values and Eigen vectors – general method – power Method, spectral method.
Numerical Solution of ordinary Differential Equations - Taylor Series Method, Picard's method, Euler's method modified Euler's method & R.K. Method.

UNIT - III	Numerical solution of partial differential equations	Lecture Hrs: 10

Numerical solution of partial differential equations –elliptical equations standard five Points formula, Diagonal five point formula –Solution of Laplace equation by Leibmann's iteration method, Poisson's equation and its applications.

UNIT - IV	Numerical Solution of Partial Differential Equations	Lecture Hrs: 8

Numerical Solution of Partial Differential Equations – Parabolic Equations Bender –Schmidt Method-Bender - Schmidt Recurrence Equation, Crank-Nicholson Difference Method.

UNIT - V	Finite Element Method	Lecture Hrs: 8

Finite Element Method – Weighted residual methods, least square method, Gelarkin's method – Finite Elements – Interpolating over the whole Domain – one dimensional case, two dimensional case – Application to Boundary value Problems.

Textbooks:

1. Higher Engineering Mathematics By B.S. Grewal Khanna Publishers.
2. Numerical Methods For Engineers By Steven C.Chapra And Raymond P.Canale – Mc Graw Hill Book Company.

Reference Books:

1. Applied Numerical Analysis By Curtis. F.Gerald- Addeson Wesely Publishing Company.
2. C-Language And Numerical Methods By C-Xavier. New Age International Publishers.

3. Computational Methods For Partial Differential Equations By M.K.Jain, SKR Lyengar, R.K.Jain.
Online Learning Resources:
After completion of this course the student should be able to : • Understand the concept and steps of calculus of variation. • Solve ordinary and partial differential equations numerically. • Solve the initial and boundary value problems numerically. • Solve the 1-D and 2-D problems using finite element method. • Identify, formulate and solve structural engineering problems.

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M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	DESIGN of PRESTRESSED CONCRETE (PE-II)	L	T	P	C
21D35104b		3	0	0	3
	Semester	I			

Course Objectives: This Course Will Enable Students:

- Familiarize students with concrept of prestressing and analysis of prestress
- Design and analysis of pretension and post tensioned concrete memebers
- Determination of deflections of prestressed members
- To calculate the losses of prestress,creep and shrinkage.

Course Outcomes (CO): Student will be able to

- To understand the basic concepts about prestressed concrete and analysis of prestress
- Estimate the effective losses in prestress
- Analyse the effect of prestressing force in the beahviour of beams in flexure
- To design shear, torsion and transmission length in prestressed concrete members
- Design of compression and tension members as per codes of practice

UNIT - I — Lecture Hrs:10

INTRODUCTION: Development of Prestressed Concrete –Advantages and Disadvantages of PSC Over RCC –General Principles of Pre-Stressing-Pre Tensioning and Post Tensioning –Materials Used in PSC-High Strength Concrete –High Tension Steel-Different Types /Methods/Systems of Prestressing.

UNIT - II — Lecture Hrs:10

Losses of Prestress: Estimation of The Loss of Prestress Due To Various Causes Like Elastic Shortening of Concrete ,Creep of Concrete, Shrinkage of Concrete, Relaxation of Steel, Slip in Anchorage and Friction.

UNIT - III — Lecture Hrs:10

Flexure & Deflections: Analysis of Sections for Flexure in Accordance With Elastic Theory-Allowable Stresses-Design Criteria As Per I.S Code of Practice –Elastic Design of Beams (Rectangular, I and T Sections) for Flexure –Introduction To Partial Prestressing. Introduction-Factors Influencing Deflections-Short Term and Long Term Deflections of Un-cracked and Cracked Members.

UNIT - IV — Lecture Hrs:10

Shear, Bond, Bearing and Anchorage: Shear in PSC Beams –Principal Stresses –Conventional Elastic Design for Shear-Transfer of Prestress in Pre-tensioned Members-Transmission Length –Bond Stresses-Bearing At Anchorage –Anchorage Zone Stresses in Post-Tensioned Members-Analysis and Design of End Blocks by Guyon, Magnel and Approximate Methods –Anchorage Zone Reinforcements.

UNIT - V — Lecture Hrs:10

Statistically Indeterminate Structures: Introduction –Advantages and Disadvantages of Continuity –Layouts for Continuous Beams-Primary and Secondary Moments –Elastic Analysis of Continuous Beams-Linear Transformation-Concordant Cable Profile-Design of Continuous Beams.

Textbooks:

1. Prestressed Concrete by N. Krishna Raju, TMH Pubilishers.
2. Prestressed Concrete by K.U.Muthu, I.K. International Publishing House.
3. Prestressed Concrete Design by Praveen Nagarajan, Pearson Pubilications.

Reference Books:

1. Design of Prestressed Concrete Structures, T.Y.Lin, Asian Publishing House, Bombay, 1953.
2. Prestressed Concrete, Vol.I&II, Y.Guyon, Wiley and Sons, 1960.
3. Prestressed Concrete Design and Construction, F.Leohhardt, Wilhelm Ernst and Shon, Berlin, 1964.
4. Reinforced concrete designers hand bood, A view point publication, C.E.Reynolds and J.C. Steedman, 1989.

5. Prestressed Concrete, Edward P.Nawy, Prentice Hall –.
6. Prestressed Concrete – by Raj Gopal, Narsoa Pubilications.

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M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	MAINTENANCE and REHABILITATION of STRUCTURES (PE – II)	L	T	P	C
21D20103a		3	0	0	3
	Semester		I		

Course Objectives: This Course Will Enable Students:

- To judge the rateof corrosion in various exposure conditions
- To conduct non destructive testing of structural elements
- To selecta sutiable bonding technique
- To judge the effect of fire and earthquake loads on discontinuites

Course Outcomes (CO): Student will be able to

- Estimate the causes for distress and deterioration of structures
- Apply the NDT for condition assessment of structures,identify damages in RC structures
- Select repair material and retrofitting strategy suitable for distress
- Formulate guidelines for repair management of deteriorated structures
- Strengthening of earthquake and fire damaged elements using various techniques.

UNIT - I Lecture Hrs:10

Influence on Serviceability and Durability:- General : Quality Assurance for Concrete Construction, As Built Concrete Properties, Strength, Permeability, Volume Changes, Thermal Properties, Cracking. Effects Due To Climate, Temperature, Chemicals, Wear and Erosion, Design and Construction Errors, Corrosion Mechanism, Effects of Cover Thickness and Cracking Methods of Corrosion Protection, Inhibitors, Resistant Steels, Coatings Cathodic Protection.

UNIT - II Lecture Hrs:10

Maintenance and Repair Strategies :- Inspection, Structural Appraisal, Economic Appraisal, Components of Equality Assurance, Conceptual Bases for Quality Assurance Schemes.

UNIT - III Lecture Hrs:10

Materials for Repair :- Special Concretes and Mortar, Concrete Chemicals, Special Elements for Accelerated Strength Gain, Expansive Cement, Polymer Concrete, Sulphur Infiltrated Concrete, Ferro Cement, Fibre Reinforced Concrete.

UNIT - IV Lecture Hrs:9

Techniques for Repair :- Rust Eliminators and Polymers Coating for Rebars During Repair, Foamed Concrete, Mortar and Dry Pack, Vacuum Concrete, Gunite and Shotcrete Epoxy Injection, Mortar Repair for Cracks, Shoring and Underpinning.

UNIT - V Lecture Hrs:9

Case Studies :- Repairs To Overcome Low Member Strength, Deflection, Cracking, Chemical Disruption, Weathering, Wear, Fire, Leakage, Marine Exposure.

Textbooks:

1. Dension Campbell, Allen and Harold Roper, Concrete Structures, Materials, Maintenance and Repair, Longman Scientific and Technical, U.K. 1991.
2. RT.Allen and S.C. Edwards, Repair of Concrete Structures, Blakie and Sons, UK, 1987.
3. MS. Shetty, Concrete Technology – Theory and Practice, S.Chand and Company, New Delhi, 1992.

Reference Books:

1. Santhakumar, A.R.Training Course Notes on Damage Assessment and Repair in Low Cost Housing RHDC-NBO Anna University, Madras, July, 1992.
2. Raikar, R.N.Learning From Failures – Deficiencies in Design, Construction and Service – R&D Centre (SDCPL), Raikar Bhavan, Bombay, 1987.
3. N.Palaniappan, Estate Management, Anna Institute of Management, Madras Sep. 1992.
4. F.K.Garas, J.L.Clarke, GST Armer, Structural Assessment, Butterworths, UK Aporil 1987.

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M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	DESIGN of BRIDGES	L	T	P	C
21D20103b	(PE-II)	3	0	0	3
	Semester	I			

Course Objectives: This Course Will Enable Students:

- To understand the various types of bridges
- To understand the codal provisions for loading and design standards of bridges
- To design the superstructure of bridge using different methods and loading conditions
- To understand the design of bearings

Course Outcomes (CO): Student will be able to

- Finalize with the usage of codal provisions in the design of bridges
- Analyze and design substructure elements of bridges
- Analyze and design various types of bridges like t-beam bridge,slab bridge ,box culvert.
- To analyze and design of T beam bridge

UNIT - I Lecture Hrs:10

Introduction – Classification, Investigations and Planning, Choice of Type – Economic Span Length – IRC Specifications for Road Bridges, Standard Live Loads, Other Forces Acting on Bridges, General Design Considerations.

UNIT - II Lecture Hrs:10

Design of Box Culverts – General Aspects – Design Loads – Design Moments, Shears and Thrusts – Design of Critical Section.

Design of Slab Bridges – Effective Width of Analysis – Workings Stress Design and Detailing of Slab Bridges for IRC Loading.

UNIT - III Lecture Hrs:10

T-Beam Bridges – Introduction – Wheel Load Analysis – B.M. in Slab – Pigaud's Theory – Analysis of Longitudinal Girders by Courbon's Theory Working Stress Design and Detailing of Reinforced Concrete T-Beam Bridges for IRC Loading.

UNIT - IV Lecture Hrs:9

Prestressed Concrete Bridges – General Features – Advantages of Prestressed Concrete Bridges – Pre-tensioned Prestressed Concrete Bridges – Post Tensioned Prestressed Concrete Bridge Decks. Design of Post Tensioned Prestressed Concrete Slab Bridge Deck. Bridge Bearings – General Features – Types of Bearings – Forces on Bearings Basis for Selection of Bearings – Design Principles of Steel Rocker and Roller Bearings and Its Design – Design of Elastometric Pad Bearing Detailing of Elastomeric Pot Bearings.

UNIT - V Lecture Hrs:9

Piers and Abutments – General Features – Bed Block – Materials for Piers and Abutments – Types of Piers – Forces Acting on Piers – Design of Pier – Stability Analysis of Piers – General Features of Abutments – Forces Acting on Abutments – Stability Analysis of Abutments.

Textbooks:

1. Essentials of Bridges Engineering – D.Hohnson Victor Oxford & IBH Publishers Co-Private Ltd.
2. Design of Concrete Bridges MC Aswanin VN Vazrani, MM Ratwani, Khanna Publishers.
3. Bridge Engineering – S.Ponnuswamy.

Reference Books:

1. Concrete Bridge Design, Browe, R.E., C.R.Books Ltd., London, 1962.
2. Reinforced Concrete Bridges, Taylor F.W., Thomson, S.E., and Smulski E., John Wiley and Sons, New York, 1955.
3. An Introduction To Structural Design of Concrete Bridges, Derrick Beckett, Surrey University; Press, Henlely – Thomes, Oxford Shire, 1973
4. Bridge Analysis Simplified, Bakht.B.And Jaegar, L.G. Mc Graw Hill, 1985.
5. Design of Bridges – N.Krishna Raju – Oxford & IBH
6. Design of Bridge Structures – FR Jagadeesh, M.A. Jaya Ram – Eastern Economy Edition.

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ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED CONCRETE LABORATORY	L	T	P	C
21D35206		0	0	4	2
	Semester	I			

Course Objectives: The students will acquire knowledge about

- To learn the principles of workability in cement concrete.
- To learn the preliminary tests on aggregates like flakiness test, elongation test, specific gravity, bulk density fineness modulus.
- To know the compression test, Young's modulus test procedures
- To learn the mix design procedure

Course Outcomes (CO): At the end of the course, students will be able to:

- Assess the workability of cement concrete and its suitability, quality of concrete
- Assess the quality of fine and coarse aggregates after testing the aggregates according to IS specifications.
- Test the quality of cement concrete by conducting compressive strength on concrete cubes.
- Design different grades of mix design and also asses the fineness of cement, flash, silica

List of Experiments:

1. Mix Design of Concrete and Casting of Specimen
2. Mix Design of High Strength Concrete Including Casting and Testing of Specimens.
3. Fresh properties of self-compacting concrete
4. Permeability of Hardened concrete
5. Rapid chloride permeability of hardened concrete & Carbonations Studies.
6. Compressive strength split tensile strength & flexural strength of self compacting
7. concrete.
8. Young's Modulus of Concrete
9. Accelerated Curing Test on Concrete Cubes.
10. Non Destructive Tests on Concrete.
11. Mix Design of Concrete using Mineral Admixtures.
12. Bending Test on A RCC Beam Under:
    i. Single Point Load
    ii. Two Point Load

References:

1. Properties of Concrete, Neville A. M., 5th Edition, Prentice Hall, 2012.
2. Concrete Technology, Shetty M. S., S. Chand and Co., 2006.
3. Concrete Technology by A.R. Santha kumar, Oxford University Press.

Course Code	ADVANCED STRUCTURAL ENGINEERING LABORATORY	L	T	P	C
21D35106		0	0	4	2
	Semester	I			

Course Objectives: The students will acquire knowledge about

- Ddesign of experiments,
- To investigate the performance of structural elements.
- To evaluate the different testing methods and equipments.

Course Outcomes (CO): At the end of the course, students will be able to:

- Achieve Knowledge of design and development of experimenting skills.
- Understand the principles of design of experiments
- Design and develop analytical skills.
- Summerize the testing methods and equipments.

List of Experiments:

1. Load deflection characteristics of under reinforced concrete beam.
2. Load Deflection characteristics of over reinforced concrete beam.
3. Comparison of reinforced concrete beam with and without shear reinforcement.
4. Detection of reinforcement in structural members using profometer.
5. Temperature effects on compressive strength of concrete.
6. Impact strength of concrete beam.
7. Testing of Brick masonry wall.
8. Load deflection characteristics of reinforced concrete beam under cyclic loading using 500kN actuator.
9. Load deflection characteristics of reinforced concrete column under cyclic loading using 1000kN actuator.
10. Load deflection characteristics of reinforced concrete beam under torsion.
11. Ambient Vibration Testing.

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M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	RESEARCH METHODOLOGY AND IPR	L	T	P	C
21DRM101		2	0	0	2
	Semester		I		

Course Objectives:

- Identify an appropriate research problem in their interesting domain.
- Understand ethical issues understand the Preparation of a research project thesis report.
- Understand the Preparation of a research project thesis report
- Understand the law of patent and copyrights.
- Understand the Adequate knowledge on IPR

Course Outcomes (CO): Student will be able to

- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT - I | Lecture Hrs:

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, scope, and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT - II | Lecture Hrs:

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT - III | Lecture Hrs:

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT - IV | Lecture Hrs:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT - V

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Textbooks:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

Reference Books:

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Asimov, "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.

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M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	STRUCTURAL DYNAMICS	L	T	P	C
21D35201		3	0	0	3
	Semester	II			

Course Objectives: This Course Will Enable Students:

- Determine vibration characteristics of structures like frequency,amplitude,impedence and time period
- Differentiate the response of single and multi degree of freedom systems
- Determine the response of structures for pulse excitation like blast load
- Differentiate the response of Multi Degree of Freedom systems

Course Outcomes (CO): Student will be able to

- Write equation of motion for single and multi degree of freedom systems
- Understand the impact of damping on charecterstics of vibrating system
- Gain Knowledge about arbitary and pulse excitation
- Understand applications of Numerical methods in dynamics
- Analyse in various theories of failure and plasticity

UNIT - I — Lecture Hrs:10

Theory of Vibrations: Introduction –Elements of A Vibratory System – Degrees of Freedom-Continuous Systems –Lumped Mass Idealization –Oscillatory Motion –Simple Harmonic Motion – Pictorial Representation of S.H.M - Free Vibrations of Single Degree of Freedom (SDOF) Systems – Undamped and Damped –Critical Damping –Logarithmic Decrement –Forced Vibrations of SDOF Systems-Harmonic Excitation –Dynamic Magnification Factor- Bandwidth.Fundamental Objective of Dynamic Analysis-Types of Prescribed Loading- Methods of Discretization- Formulation of The Equations of Motion.

UNIT - II — Lecture Hrs:10

Single Degree of Freedom System: Formulation and Solutions of The Equation of Motion - Free Vibration Response –Response To Harmonic, Periodic, Impulsive and General Dynamic Loading – Duhamel Integral

UNIT - III — Lecture Hrs:10

Multi Degree of Freedom System: Selection of The Degree of Freedom –Evaluation of Structural Property Matrices-Formulation of The MDOF Equations of Motion –Undamped Free Vibrations-Solution of Eigen Value Problem for Natural Frequencies and Mode Shapes- Analysis of Dynamic Response –Normal Coordinates –Uncoupled Equations of Motion –Orthogonal Properties of Normal Modes-Mode Superposition Procedure

UNIT - IV — Lecture Hrs:9

Practical Vibration Analysis: Stodola Method- Fundamental Mode Analysis –Analysis of Second and Higher Modes –Holzer's Method –Basic Procedure –Transfer Matrix Procedure

UNIT - V — Lecture Hrs:9

Introduction To Earthquake Analysis: Introduction –Excitation by Rigid Base Translation – Lumped Mass Approach -SDOF and MDOF System- I.S Code Methods of Analysis.
Continuous System: Introduction –Flexural Vibrations of Beams- Elementary Case-Equation of Motion –Analysis of Undamped Free Shapes of Simple Beams With Different End Conditions-Principles of Application To Continuous Beams.

Textbooks:

1. Structural Dynamics for Earthquake Engineering,A.K.Chopra,Pearson Pubilications
2. Dynamics of Structures by Clough & Penziem
3. Structural Dynamics by Roy. R. Craig John willy & fours.

Reference Books:

1. Structural Dynamics by Mario Paz
2. I.S:1893(Latest)" Code of Practice for Earthquakes Resistant Design of Stuctures"
3. Fundamentals of Vibration, Anderson R.A, Amerind Pulblishing Co.,1972.

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M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	FINITE ELEMENT METHODS for STRUCTURAL ENGINEERING	L	T	P	C
21D20201		3	0	0	3
	Semester	II			

Course Objectives: This Course Will Enable Students:

- To provide an overview and basic fundamentals of Finite Element Analysis.
- To introduce basic aspects of finite element theory, including domain discretization, interpolation, application of boundary conditions, assembly of global arrays, and solution of the resulting algebraic systems.
- To explain the underlying concepts behind variational methods and weighted residual methods in FEM.
- Formulate simple structural problems in to finite elements

Course Outcomes (CO): Student will be able to

- Analyse and build FEA models for various Engineering problems.
- Able to identify information requirements and sources for analysis , design and evaluation
- Use professional-level finite element software to solve engineering problems.
- Interpret results obtained from FEA software solutions, not only in terms of conclusions but also awareness of limitations.

UNIT - I — Lecture Hrs:10

Introduction-Concepts of FEM –Steps Involved –Merits &Demerits –Energy Principles –Discretization –Rayleigh –Ritz Method of Functional Approximation. **Elastic Formulations:** Stress Equations-Strain Displacement Relationships in Matrix Form-Plane Stress, Plane Strain and Axi-Symmetric Bodies of Revolution With Axi Symmetric Loading

UNIT - II — Lecture Hrs:10

One Dimensional FEM-Stiffness Matrix for Beam and Bar Elements Shape Functions for ID Elements –Static Condensation of Global Stiffness Matrix-Solution –Initial Strain and Temperature Effects.

UNIT - III — Lecture Hrs:10

Two Dimensional FEM-Different Types of Elements for Plane Stress and Plane Strain Analysis –Displacement Models –Generalized Coordinates-Shape Functions-Convergent and Compatibility Requirements –Geometric Invariance –Natural Coordinate System-Area and Volume Coordinates-Generation of Element Stiffness and Nodal Load Matrices –Static Condensation.

UNIT - IV — Lecture Hrs:9

Isoparametric Formulation-Concept, Different Isoparametric Elements for 2D Analysis-Formulation of 4-Noded and 8-Noded Isoparametric Quadrilateral Elements –Lagrangian Elements-Serendipity Elements. **Axi Symmetric Analysis** –Bodies of Revolution-Axi Symmetric Modelling –Strain Displacement Relationship-Formulation of Axi Symmetric Elements.

UNIT - V — Lecture Hrs:9

Three Dimensional FEM-Different 3-D Elements, 3D Strain –Displacement Relationship-Formulation of Hexahedral and Isoparametric Solid Element.

Textbooks:

1. Finite Elements Methods in Engineering by Tirupati. R. Chandrnpatla and Ashok D. Belegundu – Pearson Education Publications.
2. Finite Element Analysis – Theory & Programming by C.S.Krishna Murthy- Tata Mc.Graw Hill Publishers
3. Finite Elements Methods in Engineering by Tirupati. R. Chandrnpatla, Universities Press India Ltd. Hyderabad.

Reference Books:

1. Finite Element Method and Its Application by Desai ,2012, Pearson Pubilications.
2. finite Element Methods by Darrel W.Pepper, Vikas Pubilishers

3. Finite Element Analysis and Procedures in Engineering by H.V.Lakshminaryana, 3rd Edition, Universities Press, Hyderabad.
4. Finite Element Analysis in Engineering Design by S.Rajasekharan, S.Chand Publications, New Delhi.
5. Finite Element Analysis by S.S. Bhavakatti-New Age International Publishers
6. Finite Element Analysis by P Seshu-PHI Learning Publications.

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M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	DESIGN of REINFORCED CONCRETE FOUNDATIONS (PE-III)	L	T	P	C
21D20202a		3	0	0	3
	Semester	II			

Course Objectives: This Course Will Enable Students:

- To explore and examine a site
- Analyse lateral soil pressures acting on to a wall
- Determine bearing capacity of a soil using different theories at different conditions
- Analyse various dynamic forces
- Design a special foundation for vibrating machinery

Course Outcomes (CO): Student will be able to

- Determine the earthpressures on foundations and retaining structures
- Analyses shallow and deep foundations
- Calculate the bearing capacity of soils and foundation settlements
- Design foundations for different machines
- Assess the influence of vibrations

UNIT - I Lecture Hrs:10

SHALLOW FOUNDATIONS-I: General Requirements of Foundations. Types of Shallow Foundations and The Factors Governing The Selection of Type of Shallow Foundation. Bearing Capacity of Shallow Foundations by Terzaghi's Theory and Meyerhof's Theory (Derivation of Expressions and Solution To Problems Based on These Theories). Local Shear and General Shear Failure and Their Identification

UNIT - II Lecture Hrs:10

SHALLOW FOUNDATIONS-II: Bearing Capacity of Isolated Footing Subjected To Eccentric and Inclined Loads. Bearing Capacity of Isolated Footing Resting on Stratified Soils- Button's Theory and Siva Reddy Analysis. Analysis and Structural Design of R.C.C Isolated, Combined and Strap Footings.

UNIT - III Lecture Hrs:10

DEEP FOUNDATIONS-I: Pile Foundations-Types of Pile Foundations. Estimation of Bearing Capacity of Pile Foundation by Dynamic and Static Formulae. Bearing Capacity and Settlement Analysis of Pile Groups. Negative Skin Friction, Pile Load Tests.Sheet Pile Walls.Cantilever Sheet Piles and Anchored Bulkheads, Earth Pressure Diagram,Determination of Depth of Embedment in Sands and Clays-Timbering of Trenches-Earth Pressure Diagrams-Forces in Struts.

UNIT - IV Lecture Hrs:9

DEEP FOUNDATIONS-II: Well Foundations-Elements of Well Foundation. Forces Acting on A Well Foundation. Depth and Bearing Capacity of Well Foundation. Design of Individual Components of Well Foundation (Only Forces Acting and Principles of Design). Problems Associated With Well Sinking.

UNIT - V Lecture Hrs:9

FOUNDATIONS in PROBLEMATIC SOILS: Foundations in Black Cotton Soils-Basic Foundation Problems Associated With Black Cotton Soils. Lime Column Techniques-Principles and Execution. Under Reamed Piles-Principle of Functioning of Under Reamed Pile-Analysis and Structural Design of Under Reamed Pile. Use of Cohesive Non Swelling (CNS) Layer Below Shallow Foundations.

Textbooks:

1. Analysis and Design of Foundations and Retaining Structures-Shamsher Prakash,Gopal Ranjan and Swami Saran.

Reference Books:

1. Analysis and Design of Foundations-J.E.Bowles
2. Foundation Design and Construction-Tomlinson
3. Foundation Design-Teng.
4. Geotechnical Engg – C.Venkatramaiah

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M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	EXPERIMENTAL STRESS ANALYSIS	L	T	P	C
21D20202b	(PE-III)	3	0	0	3
	Semester	II			

Course Objectives: This Course Will Enable Students:

- To perform NDT test and interpret the results
- To understand the science behind working of strain gauge
- Understand the practical applicationsof strain gauge
- To determine the stress distribution in anacrylic block using the concept of photoelasticity

Course Outcomes (CO): Student will be able to

1. To understand the mechanical properties of strain gaugees andapplications
2. To understand the design and performance of strain gauges
3. To understand the methodsof Non destructive testing
4. To understand the methods of photo elasticity and models

UNIT - I Lecture Hrs:10

PRINCIPLES of EXPERIMENTAL APPROACH

Merits of Experimental Analysis Introduction, Uses of Experimental Stress Analysis Advantages of Experimental Stress Analysis, Different Methods –Simplification of Problems.

UNIT - II Lecture Hrs:10

STRAIN MEASUREMENT USING STRAIN GAUGES :-

Definition of Strain and Its Relation of Experimental Determinations Properties of Strain-Gauge Systems-Types of Strain Gauges –Mechanical, Acoustic and Optical Strain Gauges. Introduction To Electrical Strain Gauges - Inductance Strain Gauges – LVDT – Resistance Strain Gauges – Various Types –Gauge Factor – Materials of Adhesion Base.

UNIT - III Lecture Hrs:10

STRAIN ROSSETTES and NON – DESTRUCTIVE TESTING of CONCRETE:-Introduction – The Three Elements Rectangular Rosette – The Delta Rosette Corrections for Transverse Strain Gauge. Ultrasonic Pulse Velocity Method –Application To Concrete. Hammer Test – Application To Concrete.

UNIT - IV Lecture Hrs:9

THEORY of PHOTOELASTICITY :-

Introduction –Temporary Double Refraction – The Stress Optic Law –Effects of Stressed Model in A Polariscope for Various Arrangements – Fringe Sharpening. Brewster's Stress Optic Law.

UNIT - V Lecture Hrs:9

TWO DIMENSIONAL PHOTOELASTICITY :-

Introduction – Isochromatic Fringe Patterns- Isoclinic Fringe Patterns Passage of Light Through Plane Polariscope and Circular Polariscope Isoclinic Fringe Patterns – Compensation Techniques – Calibration Methods – Separation Methods – Scaling Model To Prototype Stresses – Materials for Photoelasticity- Properties of Photoelastic Materials.

Textbooks:

1.Experimental Stress Analysis by J.W.Dally and W.F.Riley, College House Enterprises
2. Experimental Stress Analysis by Dr.Sadhu Singh.Khanna Publishers
3. Abdul Mubeen, "Experimental Stress Analysis", DhanpatRai and Sons, 2001.

Reference Books:

1. Experimental Stress Analysis by U.C.Jindal, Pearson Pubilications.
2. Experimental Stress Analysis by L.S.Srinath, MC.Graw Hill Company Publishers.
3. Moire Fringes in Strain Analysis, PS Theocaris, Pergammon Press, 2002.

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M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	STABILITY of STRUCTURES	L	T	P	C
21D20202c	(PE-III)	3	0	0	3
	Semester	II			

Course Objectives: This Course Will Enable Students:

- Determine stability of columns and frames
- Determine stability of beams and plates
- Use stability criteria and concepts for analyzing discrete and continuous systems,
- To form differential equations for plate buckling

Course Outcomes (CO): Student will be able to

- Apply the torisonal buckling and platesfor buckling concept
- Apply the inelastic behaviour of materials and analyse the inelastic charecter of column
- Analyse the frame structures
- Analyse the plate structures

UNIT - I Lecture Hrs:10

Formulations Related To Beam Columns : Concept of Stability, Differential Equation for Beam Columns –Beam Column With Concentrated Loads –Continuous Lateral Load –Couples -Beam Column With Built in Ends –Continuous Beams With Axial Load –Application of Trignometric Series –Determination of Allowable Stresses.

UNIT - II Lecture Hrs:10

Elastic Buckling of Bars: Elastic Buckling of Straight Columns –Effect of Shear Stress on Buckling-Eccentrically and Laterally Loaded Columns –Energy Methods –Buckling of A Bar on Elastic Foundation, Buckling of A Bar With Intermediate Compressive Forces and Distributed Axial Loads –Buckling of Bars With Change in Cross Section –Effect of Shear Force on Critical Load –Built Up Columns

UNIT - III Lecture Hrs:10

Inelastic Buckling and Torsional Buckling : Buckling of Straight Bars-Double Modulus Theory –Tangent Modulus Theory. Pure Torsion of Thin Walled Bar of Open Cross Section-Non –Uniform Torsion of Thin Walled Bars of Open Cross Section-Torsional Buckling –Buckling Under Torsion and Flexure.

UNIT - IV Lecture Hrs:9

Mathematical Treatment of Stability Problems: Buckling Problem Orthogonality Relation –Ritz Method-Timoshenko Method, Galerkin Method

UNIT - V Lecture Hrs:9

Lateral Buckling of Simply Supported Beams and Rectangular Plates : Beams of Rectangular Cross Section Subjected for Pure Bending. Derivation of Equation of Rectangular Plate Subjected To Constant Compression in Two Directions and One Direction.

Textbooks:

1. Stability of Metalic Structure by Bleich –Mc Graw Hill
2. Theory of Beam Columns Vol I by Chen & Atsuta Mc.Graw Hill
3. Timoshenko, S., and Gere., Theory of Elastic Stability, Mc Graw Hill Book Company, 1973.

Reference Books:

1. Elastic Stability of Structures, Smitses, Prentice Hall,1973.
2. Buckling of Bars Plates and Shells, Brush and Almorth., Mc Graw Hill Book Company ,1975.
3. Principles of Structural Stability Theory, Chajes, A., Prentice Hall,1974
4. Stability Theory of Structures, Ashwini Kumar, TATA Mc Graw Hill Publishing Company Ltd, New Delhi,1985.

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M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED STEEL DESIGN	L	T	P	C
21D20203a	(PE-IV)	3	0	0	3
	Semester	II			

Course Objectives: This Course Will Enable Students:

- To understand the relation between structural analysis and design provisions
- Design and analysis of girders under maximum load effects
- Design and analysis of cold formed steels under stiffened and un stiffened conditions
- Design and analysis of industry buildings

Course Outcomes (CO): Student will be able to

- Gain knowledge about plastic analysis of steel structures
- Analyze and design of girders
- Analyze and design of steel tanks and stacks
- Analyze and design of industrial buildings
- Analyze and design of light gauge steel structures

UNIT - I — Lecture Hrs:10

Design of Self Supporting Steel Stacks/Chimneys – Considerations for Preliminary Design (Industrial Requirements – Thermal Requirement – Mechanical Force Requirement – Wind Load and Dead Load Estimation) – Detailed Estimation of Wind; Dead-And Other Accidental – Loads; Analysis; Detailed Design Including Provision of Stakes /Spoilers – Design of Super Structure Only.

UNIT - II — Lecture Hrs:10

Analysis of Multi-Storey Frames Using Approximate Methods and Substitute Frame Method:
Cantilever Method &
Portal Method

UNIT - III — Lecture Hrs:10

Design of Gantry Girder – Introduction – Loads Acting on The Gantry Girder – Permissible Stresses - Types of Gantry Girders and Crane Sails – Crane Data – Maximum Moments and Shears – Design Procedure (Restricted To Electrically Operated Cranes)

UNIT - IV — Lecture Hrs:9

Theorems of Plastic Analysis, Applications To The Cases of Rectangular Portal Frames. Principles of Optimization in Structural Design – Application To Simple – Rectangular Portal Frame – Minimum Weight Design.

UNIT - V — Lecture Hrs:9

General Methods of Plastic Design: Combining Mechanics Methods, Plastic Moment Redistribution Method; Application To Few Cases of Simple Two Storied Rectangular Portal Frames Including Estimation of Deflection.

Textbooks:

1. Plastic Analysis of Structures by B.G.Neal
2. Steel Skeleton V.I and II by Baker
3. Design of Steel Structures by Vazarani and Ratwani

Reference Books:

1. Strength of Materials (Vol-II)) by Timoshenko.
2. Analysis of Steel Structure by Manohar.
3. Analysis of Steel Structure by Pinfold
4. Analysis of Steel Structure by Arya & Azmani
5. Analysis of Steel Structure by Relevant IS Codes.
6. Analysis of Steel Structure by Punmia, B.C.

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M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	FRACTURE MECHANICS	L	T	P	C
21D20203b	(PE-IV)	3	0	0	3
	Semester	II			

Course Objectives: This Course Will Enable Students:

- To design based on linear elastic fracture mechanics
- To find out the variation of plastic zone over thickness of various elements
- To know about the plane strain and plane stress in slip planes
- To understand the fracture process of concrete and different materials

Course Outcomes (CO): Student will be able to

- Acquire basic skills in fracture mechanism of brittle materials
- Apply fracture mechanics theory to calculate stress areas
- Calculate the "energy release rate" around crack tips
- Examine crack growth due to fatigue

UNIT - I — Lecture Hrs:10

Summary of Basic Problems and Concepts:
Introduction - A Crack in A Structure - The Stress At A Crack Tip - The Griffith Criterion The Crack Opening Displacement Criterion - Crack Propagation - Closure

UNIT - II — Lecture Hrs:10

The Elastic Crack – Tip Stress Field :
The Airy Stress Function - Complex Stress Functions - Solution To Crack Problems - The Effect of Finite Size - Special Cases - Elliptical Cracks - Some Useful Expressions

UNIT - III — Lecture Hrs:10

The Crack Tip Plastic Zone:
The Irwin Plastic Zone Correction - The Dugdale Approach - The Shape of The Plastic Zone - Plane Stress Versus Plane Strain - Plastic Constraint Factor - The Thickness Effect

UNIT - IV — Lecture Hrs:9

The Energy Principle:
The Energy Release Rate - The Criterion for Crack Growth - The Crack Resistance (R Curve) - Compliance , The J Integral (Definitions Only)

Plane Strain Fracture Toughness:
The Standard Test - Size Requirements - Non-Linearity – Applicability

Plane Stress and Transitional Behaviour:
Introduction - An Engineering Concept of Plane Stress - The R Curve Concept

UNIT - V — Lecture Hrs:9

The Crack Opening Displacement Criterion:
Fracture Beyond General Yield - The Crack Tip Opening Displacement - The Possible Use of The CTOD Criterion

Determination of Stress Intensity Factors:
Introduction - Analytical and Numerical Methods - Finite Element Methods, Experimental Methods (An Ariel Views Only)

Textbooks:

1. Elementary Engineering Fracture Mechanics - David Broek, Battelle, Columbus Laboratories, Columbus, Ohieo, USA
2. Fracture and Fatigue Control in Structures - John M.Barsom, Stanley T.Rolfe, Ross H.Forney
3. Rock and other Quasi-brittle materials - Surender P Shah , Stuart E Swartz,Wiley 1995.

Reference Books:

1. Analysis of Concrete Structures by fracture mechanics, Elfgren L, Routledge,1990
2. Fracture Mechanics- Applications to concrete, Victor C.Li and Z P Bazant , ACI SP118
3. Fracture Mechanics , CT Suri and Zh jin , Elsevier Academic Press,2012

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M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED REINFORCED CONCRETE DESIGN (PE-IV)	L	T	P	C
21D20203c		3	0	0	3
	Semester	II			

Course Objectives: This Course Will Enable Students:

- To design of reinforced concrete beam
- To design of reinforced concrete slab
- To analyze and design of multi storey building and Industrial Building
- To design special structures such as Deep beams,Corbels and Grid Floors

Course Outcomes (CO): Student will be able to

- Design the strength and serviceability of reinforced concrete elements
- Design special reinforced concrete elements
- Analyse and design of slabs and grid floor
- Design the inelastic behaviour of concrete beams

UNIT - I Lecture Hrs:10

Deflection of Reinforced Concrete Beams and Slabs:
Introduction -Short-Term Deflection of Beams and Slabs -Deflection Due To -Imposed Loads - Short- Term Deflection of Beams Due To Applied Loads- Calculation of Deflection by IS 456 - Calculation of Deflection by BS 8110 - Deflection Calculation by Eurocode – ACI Simplified Method - Deflection of Continuous Beams by IS 456 - Deflection of Cantilevers - Deflection of Slabs

UNIT - II Lecture Hrs:10

Estimation of Crack Width in Reinforced Concrete Members and Design of Deep Beams:
Introduction - Factors Affecting Crack width in Beams - Mechanism of Flexural Cracking Calculation of Crack Widths - Simple Empirical Method - Estimation of Crack width in -Beams by IS 456 of BS 8110 - Shrinkage and Thermal Cracking.

Deep Beams:
Introduction - Minimum Thickness - Steps of Designing Deep Beams - Design by IS 456 - Design According To British Practice - ACI Procedure for Design of Deep Beams - Checking for Local Failures - Detailing of Deep Beams.

UNIT - III Lecture Hrs:10

Shear in Flat Slabs and Flat Plates:
Introduction - Checking for One-Way (Wide Beam) Shear - Two-Way (Punching) Shear Permissible Punching Shear - Shear Due To Unbalanced Moment (Torsional Moments) Calculation of J Values - Strengthening of Column Areas for Moment Transfer by Torsion Which Produces Shear - Shear Reinforcement Design - Effect of Openings in Flat Slabs - Recent Revisions in ACI 318 - Shear in Two – Way Slabs With Beams.

UNIT - IV Lecture Hrs:9

Design of Plain Concrete Walls and Shear Walls:
Introduction - Braced and Unbraced Walls - Slenderness of Walls- Eccentricities of Vertical Loads At Right Angles To Wall - Empirical Design Method for Plane Concrete Walls Carrying Axial Load - Design of Walls for In-Plane Horizontal Forces - Rules for Detailing of Steel in Concrete Walls

Design of Shear Walls:
Introduction - Classification of Shear Walls - Classification According To Behavior - Loads in Shear Walls - Design of Rectangular and Flanged Shear Walls - Derivation of Formula for Moment of Resistance of Rectangular Shear Walls

UNIT - V Lecture Hrs:9

Design of Reinforced Concrete Members for Fire Resistance : Introduction - ISO 834 Standard Heating Conditions- Grading Or Classification - Effect of High Temperature on Steel and Concrete - Effect of High Temperatures on Different Types of Structural Members - Fire Resistance by Structural Detailing From Tabulated Data - Analystical Determination of The Ultimate Bending Moment Capacity of Reinforced Concrete Beams Under Fire - Other Considerations

Textbooks:

1. Reinforced Concrete Structural Elements: Behaviour, Analysis and Design, P.Purushothaman, Tata Mcgraw Hill.
2. Reinforced Concrete Desigers Hand Bood, C.E. Reynolds and J.C. Steedman, A View Point Publication.
3. Advanced Reinforced Concrete Design , Varghese PC, Prentice Hall of India,2008

Reference Books:

1. Limit State Design of Reinforced Concrete Structures by P.Dayaratnam, Oxford & Ibh Publishers.
2. Advanced RCC by N.Krishna Raju, Cbs Publishers & Distributors.
3. Reinforced Cement Concrete Structures – Devdas Menon & Unnikrishna Pillai, Tata Mcgraw Hill

Course Code	COMPUTER AIDED DESIGN LABORATORY	L	T	P	C
21D20204		0	0	4	2
	Semester	II			

Course Objectives: The students will acquire knowledge about

- To learn the software applications in structural engineering.
- To learn the analysis of plane, space truss and frames subjected to different types of loadings.
- To draw the detailing of RCC members and to learn the estimations.
- To study the design concepts of steel members like truss, beams and columns.

Course Outcomes (CO): At the end of the course, students will be able to:

- Understand the software usages for structural members.
- Able to analyse plane, space frames and dynamic response and natural frequency for beams and frames.
- Able to design, detailing and estimations of RC members.
- Able to design the steel members like truss, beams and columns.

List of Experiments:

1. Analysis of Cantilever, Simply Supported Beam, Fixed Beams, Continuous Beams for Different Loading Conditions.
2. Design of R.C.C. Beams, Slabs, Foundations.
3. Design of Steel Tension Members
4. Reinforcement Detailing in Beam Using Graphics.
5. Reinforcement Detailing in Slabs Using Graphics.
6. Reinforcement Detailing in Foundation Using Graphics.

Course Code	ADVANCED STRUCTURAL DESIGN LAB	L	T	P	C
21D20205		0	0	4	2
	Semester	II			

Course Objectives: The students will acquire knowledge about

- To develop MATLAB codes for solution of simultaneous linear equations.
- To construct codes for 1D Finite Element problems.
- To identify methods to code for numerical integration techniques & statistical methods.
- To model finite difference methods.

Course Outcomes (CO): At the end of the course, students will be able to:

- Design and Detail all the Structural Components of Frame Buildings.
- Design and Detail complete Multi-Storey Frame Buildings
- design the frames using Excel sheets
- Design the Shells and folded plates using ETABS

List of Experiments:

1. Static and Dynamic analysis of Building structure using software (ETABS / STAADPRO)
2. Design of RCC and Steel structure using software (ETABS / STAADPRO)
3. Analysis of folded plates and shells using software.
4. Preparation of EXCEL sheets for structural design.

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COURSE STRUCTURE & SYLLABI

Course Code	**EARTHQUAKE RESISTANT DESIGN of BUILDINGS (PE-V)**	**L**	**T**	**P**	**C**
21D35301a		**3**	**0**	**0**	**3**
	Semester	**III**			

Course Objectives: This Course Will Enable Students:

- To understant effects of earthquakes on engineering structures and its measurement
- To apply dynamics loadson various structures
- To design buildings for earthquake loads as per IS Codes
- To understand and implement the concept of ductility in Earthquake Resistant Design

Course Outcomes (CO): Student will be able to

- Illustrate the measurement of earthquakes and their effect on engineering structures
- Analyse the free and forced vibration response of single degree and multi degree of freedom and continuous systems
- Apply the basic principles of conceptual design of Earthquake Resistant buildings
- Learn the various seismic control methods

UNIT - I | Lecture Hrs:10

Engineering Seismology :
Earthquake – Causes of Earthquake – Earthquakes and Seismic Waves – Scale and Intensity of Earthquakes – Seismic Activity – Measurements of Earth Quakes – Seismometer- Strong Motion Accelerograph / Field Observation of Ground Motion – Analysis of Earthquakes Waves – Earth Quake Motion – Amplification of Characteristics of Surface Layers – Earthquake Motion on The Ground Surface

UNIT - II | Lecture Hrs:10

Vibration of Structures Under Ground Motion:
Elastic Vibration of Simple Structures – Modelling of Structures and Equations of Motion – Free vibrations of Simple Structures – Steady State Forced Vibrations – Non Steady State Forced Vibrations – Response Spectrum Representations; Relation Between The Nature of The Ground Motion and Structural Damage.

UNIT - III | Lecture Hrs:10

Lateral Force Procedure Seismic Base Shear – Seismic Design Co-Efficient - Vertical Distribution of Seismic Forces and Horizontal Shear – Twisting Moment - Over Turning Moment – Vertical Seismic Load and Orthogonal Effects Lateral Deflection – P- Δ Characteristics Effect – Soil Structure Interaction. Seismic – Graphs Study, Earthquake Records for Design – Factors Affecting Accelerogram Characteristics - Artificial Accelerogram – Zoning Map. Dynamic – Analysis Procedure: Model Analysis – Inelastic – Time History Analysis Evaluation of the Results.

UNIT - IV | Lecture Hrs:9

Earthquake – Resistant Design of Structural Components and Systems:
Introduction – Monolithic Reinforced – Concrete Structures – Precast Concrete Structures – Prestressed Concrete Structures – Steel Structures – Composite – Structures, Masonry Structures – Timber Structures.

UNIT - V | Lecture Hrs:9

Fundamentals of Seismic Planning: Selection of Materials and Types of Construction Form of Superstructure – Framing Systems and Seismic Units – Devices for Reducing. Earthquake Loads,

Textbooks:

1. Design of Earthquake Resistant Structures by Minoru Wakabayashi.
2. Strucutural Dynamics for Earthquake Engineering", A.K.Chopra,Pearson Pubilications.
3. Dynamics of Structures. R.W.Clough, Mc Graw – Hill, 2nd Edition,

Reference Books:

1. Fundamentals of Earthquake Engineering,N.M Newmark and E.Rosenblueth, Prentice Hall,1971.
2. Earthquake Design Practice for Buildings. David Key," Thomas Telford,London,1988

3. Earthquake Engg; R.L. Wegel, Prentice Hall 12nd Edition 1989.
4. Design of Multi –Storied Buildings for Earthquake Ground Motions J.A. Blume, N.M. Newmark, L.H. Corning.,', Portland Cement Association, Chicago,1961
5. I.S.Codes No. 1893,4326,13920.
6. Earthquake Resistant Design by Pankaj Agarwal.

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M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	LOW COST HOUSING TECHNIQUES	L	T	P	C
21D25301a	(PE- V)	3	0	0	3
	Semester	II			

Course Objectives: This course will enable students:

- To possess comprehensive knowledge of planning, design, evaluation, construction and financing of housing projects.
- To focuses on cost effective construction materials and methods.
- To understand on the principles of sustainable housing policies and programmes.
- to adopt the suitable techniques in rural and disaster prone areas by using locally available materials.

Course Outcomes (CO): Student will be able to

- Development of construction technology and innovative techniques as tools to address demand mass construction
- Knowledge of eco friendly material with their application
- Learn the use of locally available material according to their availability and maintenance

UNIT - I		Lecture Hrs:10

Housing Scenario
Introduction - Status of Urban Housing - Status of Rural Housing
Housing Finance:
Introducing - Existing Finance System in India - Government Role As Facilitator - Status At Rural Housing Finance - Impedimently in Housing Finance and Related Issues
Land Use and Physical Planning for Housing
Introduction - Planning of Urban Land - Urban Land Ceiling and Regulation Act - Efficiency of Building Bye Lass - Residential Densities
Housing The Urban Poor
Introduction - Living Conditions in Slums - Approaches and Strategies for Housing Urban Poor

UNIT - II		Lecture Hrs:10

Development and Adoption of Low Cost Housing Technology
Introduction - Adoption of Innovative Cost Effective Construction Techniques - Adoption of Precast Elements in Partial Prefatroices - Adopting of Total Prefactcation of Mass Housing in India- General Remarks on Pre Cast Rooting/Flooring Systems -Economical Wall System - Single Brick Thick Loading Bearing Wall - 19cm Thick Load Bearing Masonery Walls - Half Brick Thick Load Bearing Wall - Flyash Grypsym Thick for Masonry - Stone Block Masonery - Adoption of Precast R.C. Plank and Join System for Roof/Floor in The Building

UNIT - III		Lecture Hrs:10

Alternative Building Materials for Low Cost Housing
Introduction - Substitute for Scarce Materials – Ferrocement - Gypsum Boards - Timber Substitutions - Industrial Wastes - Agricultural Wastes - Fitire Starateru; for ,P,Topm of Alternative Building Maintenance
Low Cost Infrastructure Services:
Introduce - Present Status - Technological Options - Low Cost Sanitation - Domestic Wall - Water Supply, Energy

UNIT - IV		Lecture Hrs:9

Rural Housing:
Introduction Traditional Practice of Rural Housing Continuous - Mud Housing Technology
Mud Roofs - Characteristics of Mud - Fire Treatment for Thatch Roof - Soil Stabilization - Rural Housing Programs

UNIT - V		Lecture Hrs:9

Housing in Disaster Prone Areas:
Introduction – Earthquake - Damages To Houses - Traditional Prone Areas - Type of Damages and

Railways of Non-Engineered Buildings - Repair and Restore Action of Earthquake Damaged Non-Engineered Buildings Recommendations for Future Constructions. Requirement's of Structural Safety of Thin Precast Roofing Units Against Earthquake Forces, Status of R&D in Earthquake Strengthening Measures - Floods, Cyclone, Future Safety
Textbooks:
1. Building Materials for Low –Income Houses – International Council for Building Research Studies and Documentation. 2. Hand Book of Low Cost Housing by A.K.Lal – Newage International Publishers. 3. Modern Trends in Housing in Developing Countries – A.G. Madhava Rao, D.S. Ramachandra Murthy & G.Annamalai.
Reference Books:
1. Properties of Concrete – Neville A.M. Pitman Publishing Limited, London. 2. Light Weight Concrete, Academic Kiado, Rudhai.G – Publishing Home of Hungarian Academy of Sciences 1963. 3. Low Cost Housing – G.C. Mathur.

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M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	BUILDING CONSTRUCTION MANAGEMENT	L	T	P	C
21D25301b	(PE- V)	3	0	0	3
	Semester	II			

Course Objectives: This Course Will Enable Students:

- To create construction project cost estimates.
- Analyze construction documents for planning and management of construction processes.
- Understand the legal implications of contract, common, and regulatory law to manage a construction project.
- Understand different methods of project delivery and the roles and responsibilities of all constituencies involved in the design and construction process.

Course Outcomes (CO): Student will be able to

- Plan, coordinate and control of a project from beginning to completion.
- Adopting the most effect method for meeting the requirement in order to produce a functionally and financially viable project.
- Implement different methods of project delivery
- Follow the legal provisions implied

UNIT - I — Lecture Hrs:10

Introduction – Types Constructions Public and Private Contract Management – Scrutinizing Tenders and Acceptance of Tenders, Contracted, Changes and Terminating of Contract – Subcontracts Construction Organizations – Organizational Chart-Decentralization Payrolls and Records – Organization Chart of A Construction Company.

UNIT - II — Lecture Hrs:10

Construction Practices – Times Management – Bar Chart, CPM, PERT – Progress Report

UNIT - III — Lecture Hrs:

Resources Management and Inventor- Basic Concepts Equipment Management, Material Management Inventory Control.

UNIT - IV — Lecture Hrs:9

Accounts Management – Basic Concepts, Accounting System and Book Keeping, Depreciation, Balance Sheet, Profit and Loss Account, Internal Auditing. Quality Control by Statistical Methods, Sampling Plan and Control Charts, Safety Requirements.

UNIT - V — Lecture Hrs:9

Cost and Financial Management – Cost Volume Relationship, Cost Control System, Budget Concept of Valuation, Cost of Equity Capital Management Cash. Labor and Industrial; Laws – Payment of Wages Act. Contract Labor, Workmen's Compensation, Insurance, Industrial Disputes Act.

Textbooks:

1. Construction Project Management by Jha ,Pearson Pubilications,New Delhi.
2. Construction Technology by Subir K.Sarkar and Subhajit Saraswati – Oxford Higher Education- Univ.Press, Delhi.

Reference Books:

1. Project Planning and Control With PERT and CPM by Dr.B.C.Punmia, K.K.Khandelwal, Lakshmi Publications New Delhi.
2. Optimal Design of Water Distribution Networks P.R.Bhave, Narosa Publishing House 2003.
3. Total Project Management, The Indian Context- by : P.K.JOY- Mac Millan Publishers India Limited.

AUDIT COURSE-I

Course Code	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
21DAC101a		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- Understand the essentials of writing skills and their level of readability
- Learn about what to write in each section
- Ensure qualitative presentation with linguistic accuracy

Course Outcomes (CO): Student will be able to

- Understand the significance of writing skills and the level of readability
- Analyze and write title, abstract, different sections in research paper
- Develop the skills needed while writing a research paper

UNIT - I — Lecture Hrs:10

1Overview of a Research Paper- Planning and Preparation- Word Order- Useful Phrases - Breaking up Long Sentences-Structuring Paragraphs and Sentences-Being Concise and Removing Redundancy -Avoiding Ambiguity

UNIT - II — Lecture Hrs:10

Essential Components of a Research Paper- Abstracts- Building Hypothesis-Research Problem - Highlight Findings- Hedging and Criticizing, Paraphrasing and Plagiarism, Cauterization

UNIT - III — Lecture Hrs:10

Introducing Review of the Literature – Methodology - Analysis of the Data-Findings - Discussion-Conclusions-Recommendations.

UNIT - IV — Lecture Hrs:9

Key skills needed for writing a Title, Abstract, and Introduction

UNIT - V — Lecture Hrs:9

Appropriate language to formulate Methodology, incorporate Results, put forth Arguments and draw Conclusions

Suggested Reading

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) Model Curriculum of Engineering & Technology PG Courses [Volume-I]
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	DISASTER MANAGEMENT	L	T	P	C
21DAC101b		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- Learn to demonstrate critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from Multiple perspectives.
- Developanunderstandingofstandardsofhumanitarianresponseandpracticalrelevanceinspecific types of disasters and conflict situations
- Criticallyunderstandthestrengthsandweaknessesofdisastermanagementapproaches,planningand programming in different countries, particularly their home country or the countries they work in

UNIT - I

Introduction:
Disaster:Definition,FactorsandSignificance;DifferenceBetweenHazardandDisaster;Naturaland Manmade Disasters: Difference, Nature, Types and Magnitude.

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:
Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes,Volcanisms,Cyclones,Tsunamis,Floods,DroughtsandFamines,Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT - III

Disaster Preparedness and Management:
Preparedness: Monitoring of Phenomena Triggering ADisasteror Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT - IV

Risk Assessment Disaster Risk:
Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. TechniquesofRiskAssessment,GlobalCo-OperationinRiskAssessmentand Warning, People's Participation in Risk Assessment. Strategies for Survival.

UNIT - V

Disaster Mitigation:
Meaning,ConceptandStrategiesofDisasterMitigation,EmergingTrendsInMitigation.Structural Mitigationand Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Suggested Reading

1. R.Nishith,SinghAK,"DisasterManagementinIndia:Perspectives,issuesandstrategies
2. "'New Royal book Company..Sahni,PardeepEt.Al.(Eds.),"DisasterMitigationExperiencesAndReflections",PrenticeHall OfIndia, New Delhi.

3. GoelS.L.,DisasterAdministrationAndManagementTextAndCaseStudies",Deep&Deep Publication Pvt. Ltd., New Delhi

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M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	SANSKRITFOR TECHNICAL KNOWLEDGE	L	T	P	C
21DAC101c		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- LearningofSanskrittodevelopthelogicinmathematics,science&othersubjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge
- Knowledge from ancientliterature

Course Outcomes (CO): Student will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science &technology can be understood
- Being a logical language will help to develop logic in students

UNIT - I

Alphabets in Sanskrit,

UNIT - II

Past/Present/Future Tense, Simple Sentences

UNIT - III

Order, Introduction of roots

UNIT - IV

Technical information about Sanskrit Literature

UNIT - V

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested Reading

1.“Abhyaspustakam” –Dr.Vishwas, Sanskrit-Bharti Publication, New Delhi
2.“Teach Yourself Sanskrit” Prathama Deeksha- VempatiKutumbshastri, RashtriyaSanskrit Sansthanam, New Delhi Publication
3.“India’s Glorious ScientificTradition” Suresh Soni, Ocean books (P) Ltd.,New Delhi

AUDIT COURSE-II

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M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	PEDAGOGY STUDIES	L	T	P	C
21DAC201a		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

- Reviewexistingevidenceonthereviewtopictoinformprogrammedesignandpolicy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes (CO): Student will be able to

Students will be able to understand:

- Whatpedagogicalpracticesarebeingusedbyteachersinformalandinformalclassrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- Howcanteachereducation(curriculumandpracticum)andtheschoolcurriculumand guidance materials best support effective pedagogy?

UNIT - I

Introduction and Methodology: Aims and rationale, Policy back ground, Conceptual frame work and terminology Theories oflearning,Curriculum,Teachereducation.Conceptualframework,Research questions**.** Overview of methodology and Searching.

UNIT - II

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT - III

Evidence on theeffectivenessofpedagogicalpractices,Methodologyfortheindepthstage:quality assessmen t of included studies. How can teacher education (curriculumandpracticum) andthescho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of th body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT - IV

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacherandthecommunity.Curriculumandassessment,Barrierstolearning:limitedresourcesand large class sizes

UNIT - V

Researchgapsandfuturedirections: Researchdesign**,**Contexts**,**Pedagogy**,**Teachereducation**,** Curriculum and assessment**,** Dissemination and research impact.

Suggested Reading

1. AckersJ,HardmanF(2001)ClassroominteractioninKenyanprimaryschools,Compare, 31 (2): 245-261.
2. AgrawalM(2004)Curricularreforminschools:Theimportanceofevaluation,Journalof
3. Curriculum Studies, 36 (3): 361-379.
4. AkyeampongK(2003) Teacher training in Ghana - does it count? Multi-site teachereducation research project (MUSTER) country report 1. London: DFID.

5. Akyeampong K, LussierK, PryorJ, Westbrook J (2013)Improving teaching and learning of basic maths and reading in Africa: Does teacherpreparation count?International Journal Educational Development, 33 (3): 272–282.
6. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
   Chavan M (2003)ReadIndia: A mass scale, rapid, 'learning to read'campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

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COURSE STRUCTURE & SYLLABI

Course Code	STRESSMANAGEMENT BY YOGA	L	T	P	C
21DAC201b		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

- To achieve overall health of body and mind
- To overcome stres

Course Outcomes (CO): Student will be able to

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT - I

Definitions of Eight parts of yog.(Ashtanga)

UNIT - II

Yam and Niyam.

UNIT - III

Do`sand Don't'sin life.

i) Ahinsa,satya,astheya,bramhacharyaand aparigrahaii) Shaucha,santosh,tapa,swadhyay,ishwarpranidhan

UNIT - IV

Asan and Pranayam

UNIT - V

i)Variousyogposesand theirbenefitsformind &body

ii)Regularizationofbreathingtechniques and its effects-Types ofpranayam

Suggested Reading

1.'Yogic Asanas forGroupTarining-Part-I": Janardan SwamiYogabhyasiMandal, Nagpur
2."Rajayogaor conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course Code	PERSONALITY DEVELOPMENT THROUGHLIFE ENLIGHTENMENTSKILLS	L	T	P	C
21DAC201c		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

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

Course Outcomes (CO): Student will be able to

- StudyofShrimad-Bhagwad-Geetawillhelpthestudentindevelopinghispersonalityand achieve the highest goal in life
- The person who has studied Geetawilllead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT - I

Neetisatakam- Holistic development of personality
Verses-19,20,21,22(wisdom)
Verses-29,31,32(pride &heroism)
Verses-26,28,63,65(virtue)

UNIT - II

Neetisatakam- Holistic development of personality
Verses-52,53,59(dont's)
Verses-71,73,75,78(do's)

UNIT - III

Approach to day to day work and duties.
ShrimadBhagwadGeeta:Chapter2-Verses41,47,48,
Chapter3-Verses13,21,27,35,Chapter6-Verses5,13,17,23,35,
Chapter18-Verses45,46,48.

UNIT - IV

Statements of basic knowledge.
ShrimadBhagwadGeeta:Chapter2-Verses 56,62,68
Chapter12 -Verses13,14,15,16,17,18
Personality of Rolemodel. Shrimad Bhagwad Geeta:

UNIT - V

Chapter2-Verses 17,Chapter3-Verses36,37,42,
Chapter4-Verses18,38,39
Chapter18– Verses37,38,63

Suggested Reading

1.“SrimadBhagavadGita”bySwamiSwarupanandaAdvaitaAshram(PublicationDepartment), Kolkata
2.Bhartrihari'sThree Satakam (Niti-sringar-vairagya) by P.Gopinath, RashtriyaSanskrit Sansthanam, New Delhi.

OPEN ELECTIVE

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA
M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	COST MANAGEMENT OF ENGINEERING PROJECTS	L	T	P	C
21DOE301a		3	0	0	3
	Semester	I			

Course Objectives:

- To explain cost concepts and objectives of costing system and cost management process
- To provide knowledge and explain Cost behaviour in relation to Volume and Profit and pricing decisions.
- To know the concepts of target costing, life cycle costing and activity based cost management in a project or business.
- To discuss on budget and budgetary control , type of budgets in a business to control costs
- To provide knowledge on project, types of projects, stages of project execution, types of project contracts and project cost control.

Course Outcomes (CO): Student will be able to

- Know the cost management process and types of costs
- Learn and apply different costing methods under different project contracts
- To understand relationship of Cost-Volume and Profit and pricing decisions.
- Prepare budgets and measurement of divisional performance.
- Acquires knowledge on various types of project contracts, stages to execute projects and controlling project cost..

UNIT - I — Lecture Hrs:10

Introduction and Overview of the Strategic Cost Management Process - Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT - II — Lecture Hrs:12

Cost Behavior and Profit Planning: Marginal Costing- Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems; Pareto Analysis Just-in-time approach, Theory of constraints.; Divisional performance management: - Measurement of Divisional profitability - pricing decisions - transfer pricing.

UNIT - III — Lecture Hrs:10

Target costing- Life Cycle Costing - Activity-Based Cost management:- Activity based costing- Value-Chain Analysis- Bench Marking; Balanced Score Card.

UNIT - IV — Lecture Hrs:10

Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT - V — Lecture Hrs:12

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

Textbooks:

1. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
2. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler

publisher
Reference Books:
1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi 2. Charles T. Horngren and George Foster, Advanced Management Accounting 3. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd
Online Learning Resources:
https://nptel.ac.in/courses/105/104/105104161/ https://nptel.ac.in/courses/112/102/112102106/

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M.TECH. IN STRUCTURAL ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	INDUSTRIAL SAFETY	L	T	P	C
21DOE301b		3	0	0	3
	Semester	III			

Course Objectives:

- To know about Industrial safety programs and toxicology, Industrial laws , regulations and source models
- To understand about fire and explosion, preventive methods, relief and its sizing methods
- To analyse industrial hazards and its risk assessment.

Course Outcomes (CO): Student will be able to

- To list out important legislations related to health, Safety and Environment.
- To list out requirements mentioned in factories act for the prevention of accidents.
- To understand the health and welfare provisions given in factories act.

UNIT - I Lecture Hrs:

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT - II Lecture Hrs:

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT - III Lecture Hrs:

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working andapplications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT - IV Lecture Hrs:

Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT - V Lecture Hrs:

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Textbooks:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.

Reference Books:

1.Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
2. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Course Code	**BUSINESS ANALYTICS**	**L**	**T**	**P**	**C**
21DOE301c		**3**	**0**	**0**	**3**
	Semester			**III**	

Course Objectives:

- The main objective of this course is to give the student a comprehensive understanding of business analytics methods.

Course Outcomes (CO): Student will be able to

- Students will demonstrate knowledge of data analytics.
- Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
- Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
- Students will demonstrate the ability to translate data into clear, actionable insights.

UNIT - I — Lecture Hrs:

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst. Stakeholders: the project team, management, and the front line, Handling Stakeholder Conflicts.

UNIT - II — Lecture Hrs:

Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

UNIT - III — Lecture Hrs:

Forming Requirements: Overview of Requirements, Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents. Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

UNIT - IV — Lecture Hrs:

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements. Managing Requirements Assets: Change Control, Requirements Tools

UNIT - V — Lecture Hrs:

Recent Trands in: Embedded and colleborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

Textbooks:

1. Business Analysis by James Cadle et al.
2. Project Management: The Managerial Process by Erik Larson and, Clifford Gray

Reference Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

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M.TECH. IN ELECTRICAL POWER SYSTEMS / POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

SEMESTER – I

S. No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D49101	Advanced Power System Protection	PC	3	0	0	3
2.	21D49102	Power System Security and State Estimation	PC	3	0	0	3
3.	21D49103a 21D49103b 21D49103c	**Program Elective I:** Energy Auditing and Management Modelling and Analysis of HVDC Systems Power System Optimization	PE	3	0	0	3
4.	21D49104a 21D49104b 21D49104c	**Program Elective II:** Solar & Wind Energy Conversion Systems Smart Grid Technologies Electric Vehicle Engineering	PE	3	0	0	3
5.	21D49105	Machines & Power Systems Lab	PC	0	0	4	2
6.	21D49106	Power Systems Simulation Lab	PC	0	0	4	2
7.	21DRM101	Research Methodology and IPR	MC	2	0	0	2
8.	21DAC101a 21DAC101b 21DAC101c	**Audit Course – I** English for Research paper writing Disaster Management Sanskrit for Technical Knowledge	AC	2	0	0	0
		Total					**18**

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M.TECH. IN ELECTRICAL POWER SYSTEMS/POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

SEMESTER – II

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D49201	Power System Stability and Control	PC	3	0	0	3
2.	21D49202	FACTS Controllers	PC	3	0	0	3
3.	 21D49203a 21D49203b 21D49203c	**Program Elective III** Power System Wide Area Monitoring & Control Modern Control Theory Reactive power Compensation & Management	PE	3	0	0	3
4.	 21D49204a 21D49204b 21D49204c	**Program Elective IV** Power Quality Distributed Generation and Micro grid Control EHVAC Transmission systems	PE	3	0	0	3
5.	21D49205	Renewable Energy Sources Lab	PC	0	0	4	2
6.	21D49206	FACTS Devices Simulation Lab	PC	0	0	4	2
7.	21D49207	Technical seminar	PR	0	0	4	2
8.	 21DAC201a 21DAC201b 21DAC201c	**Audit Course – II** Pedagogy Studies Stress Management for Yoga Personality Development through Life Enlightenment Skills	AC	2	0	0	0
		Total					**18**

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M.TECH. IN ELECTRICAL POWER SYSTEMS / POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

SEMSTER - III

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	 21D49301a 21D49301b 21D49301c	**Program Elective V:** Restructured power systems Reliability Engineering and Applications to Power Systems Power System Automation	PE	3	0	0	3
2.	 21DOE301e 21DOE301a 21DOE301i	**Open Elective:** Waste to Energy Cost Management of Engineering Projects IOT Applications	OE	3	0	0	3
3.	21D49302	Dissertation Phase – I	PR	0	0	20	10
4.	21D49303	Co-curricular Activities					2
Total							**18**

SEMESTER - IV

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D49401	Dissertation Phase – II	PR	0	0	32	16
Total							**16**

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M.TECH. IN ELECTRICAL POWER SYSTEMS/POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	**ADVANCED POWER SYSTEM PROTECTION**	**L**	**T**	**P**	**C**
21D49101		**3**	**0**	**0**	**3**
	Semester	**I**			

Course Objectives: To make the student

- To know construction of static relays
- To understand the operation of amplitude and phase comparators
- To comprehend the concepts of Static over current, static differential and static distance relays.
- To understand multi-input comparators and concept of power swings on the distance relays.
- To know the operation of microprocessor based protective relays

Course Outcomes (CO): Student will be able to

- Describe the construction of static relay and identify the advantages of static relay over electromagnetic relay Analyse the importance of reliability in various fields.
- Explore the operation of rectifier bridge comparators, instantaneous comparators, phase comparators, multi input comparators, static differential and distance relays
- Describe instantaneous, definite time and inverse definite minimum time over current relays.
- Analyze the concept of power swings on distance relays and to identify the microprocessor based protective relays and their operation

UNIT – I	**STATIC RELAYS & COMPARATORS**	Lecture Hrs: 8

Static relays - Basic construction of Static relays – Level detectors – Replica Impedance-Mixing circuits-General equation for two input phase and Amplitude Comparators – their types – Duality between Amplitude and Phase Comparator –Conic section characteristics–Three input Amplitude Comparator – Hybrid comparator – Switched distance schemes – Polyphase distance schemes-Phase faults scheme –Three phase scheme–Combined and Ground fault scheme.

UNIT - II	**TYPES OF STATIC RELAYS**	Lecture Hrs: 9

Instantaneous over current relay – Time over current relays - Basic principles - Definite time and Inverse definite time over current relays, directional over current relays - Static Differential Relays-Analysis of static differential relays–Static relay schemes-Dual bias transformer differential protection – Harmonic restraint relay.

UNIT - III	**NUMERICAL RELAYS:**	Lecture Hrs: 9

Advantages of Numerical Relays – Numerical network-Digital Signal processing–Estimation of Phasors – Full Cycle Fourier Algorithm – Half Cycle Fourier Algorithm- practical considerations for selection of Algorithm–Discrete Fourier Transform

UNIT - IV	**DISTANCE RELAYS AND POWER SWINGS**	Lecture Hrs: 12

Static Distance Relays - Static Impedance - reactance - MHO and Angle Impedance relay sampling comparator – Realization of reactance and MHO relay using a sampling comparator.

Effect of power swings on the performance of Distance relays- Power swing analysis - Principle of out of step tripping and blocking relays - Effect of line length and source impedance on distance relays.

UNIT - V	**MICROPROCESSOR BASED PROTECTIVE RELAYS**	Lecture Hrs: 10

Over current relays – Impedance relays – Directional relay – Reactance relay (Block diagram and flowchart approach only).Generalized mathematical expression for distance relays-Measurement of resistance and reactance – MHO and offset MHO relays – Realization of MHO characteristics – Realization of Offset MHO characteristics (Block diagram and flow chart approach only) - Basic principle of Digital computer relaying.

Textbooks:

1. T.S. Madhava Rao, Power system Protection static relay, Tata McGrawHill Publishing Company limited, 2nd Edition, 2004. 2. Badri Ram and D.N. Vishwakarma, Power system Protection and Switchgear, Tata McGraw Hill Publication Company limited, 2nd Edition, 2013.
Reference Books:
1. Bhavesh Bhalja, R. P. Maheshwari, N. G. Chothani, Protection and Switchgear, Oxford University Press, 2nd Edition, New Delhi, India, 2018. 2. Oza, B. A., N. C. Nair, R. P. Mehta, et al., Power System Protection & Switchgear, Tata McGraw Hill, New Delhi, 1st Edition, 2011.

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M.TECH. IN ELECTRICAL POWER SYSTEMS/POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	POWER SYSTEM SECURITY AND STATE ESTIMATION	L	T	P	C
21D49102		3	0	0	3
	Semester	I			

Course Objectives: To make the student

- Understand the basic concepts of network matrices, power flow methods, state estimation, and applications of power system state estimation and structure of deregulated power system.
- Analyze about admittance/impedance matrices, factors influencing power system security, network problems and power wheeling transactions.
- Implement the methods for determining the bus matrices, optimal ordering, DC power flow, AC power flow, estimating a value and Available Transfer Capability (ATC).
- Develop the algorithm for orthogonal matrix, method to identify network problems and congestion management methods and electricity sector structure.

Course Outcomes (CO): Student will be able to

- Understand the concepts of network matrices, power flow methods, contingency analysis, state estimation, and need and conditions for deregulation.
- Analyze the bus admittance/impedance matrices methods, power system security, sensitivity factors, state estimation and electricity structure model.
- Apply the methods for evaluating the bus matrices, sparsity, DC power flow, AC power flow, estimating a value and Available Transfer Capability (ATC).
- Develop the methods for state estimation, method to identify network problems and methods for congestion management.

UNIT - I	**Power System Network Matrices**	Lecture Hrs: 10

Formation of bus admittance matrices by direct inspection method and singular transformation method – Algorithm for formation of Bus impedance matrix: addition of a branch and addition of a link, removal element in Bus impedance matrix– Sparsity programming and Optimal Ordering – Numerical problems – ∏-representation of off-nominal tap transformers.

UNIT - II	**Power System Security-I**	Lecture Hrs: 9

Review of power flow methods (qualitative treatment only)– DC power flow method-simple problems – Introduction to power system security – Factors influencing power system security.

UNIT - III	**Power System Security-II**	Lecture Hrs: 10

Introduction to contingency analysis – Contingency analysis: Detection of Network problems, linear sensitivity factors –AC power flow methods– Contingency selection– Simple problems.

UNIT - IV	**State Estimation in Power System**	Lecture Hrs: 10

Power system state estimation – SCADA –EMS center, Methods of state estimation – Method of least squares, Orthogonal matrix–Properties– Givens rotation–Orthogonal decomposition–Bad data detection, Pseudo measurements and applications of power system state estimation – Simple problems.

UNIT - V	**Security in Deregulated Environment**	Lecture Hrs: 9

Need and conditions for deregulation–Electricity sector structure model – Power wheeling transactions – Congestion management methods– Available Transfer Capability (ATC) – System security in deregulation.

Textbooks:

1. Allen J. Wood and Wollenberg B.F., Power Generation Operation and control, John Wiley & Sons, 3rd edition, 2013.
2. P. Venkatesh, B.V. Manikandan, S. Charles Raja and A.Srinivasan, Electrical power systems analysis, security, and deregulation, PHI learning private limited, Delhi, 1st edition 2014.

Reference Books:

1. Nagrath I.J. and Kothari D.P., Modern Power System Analysis, TMH, New Delhi, 3rd Edition, 2004.

2. John J. Grainger and William D. Stevenson, Power System Analysis, Tata McGraw-Hill, 1st edition, 2003.

Online Learning Resources:

1. https://nptel.ac.in/content/storage2/courses/108106022/LECTURE%205.pdf
2. https://nptel.ac.in/content/storage2/courses/108101040/download/Lec-26.pdf

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M.TECH. IN ELECTRICAL POWER SYSTEMS/POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	ENERGYAUDITING AND MANAGEMENT (PE-I)	L	T	P	C
21D49103a		3	0	0	3
	Semester	I			

Course Objectives: To make the student

- To understand the current energy scenario and importance of energy conservation
- To acquire the knowledge about different energy efficient devices
- To measure thermal efficiency and other renewable resources.
- To design suitable energy monitoring system to analyze and optimize the energy consumption in an electrical system.

Course Outcomes (CO): Student will be able to

- Understand the current energy scenario and importance of energy conservation
- Acquire the knowledge about different energy efficient devices
- Measure efficiency in renewable energy resources.
- Identify the equipment and areas of a system where energy conservation and Audit is necessary

UNIT - I	Energy audit and demand side management (DSM) in power utilities	Lecture Hrs: 10

Energy Scenario & Conservation -Demand Forecasting Techniques- Integrated Optimal Strategy for Reduction of T&D Losses - DSM Techniques and Methodologies- Loss Reduction in Primary and Secondary Distribution system and capacitors - Energy Management — Role of Energy Managers – Energy Audit-Metering
.

UNIT - II	Energy audit	Lecture Hrs: 9

Energy audit concepts - Basic elements and measurements - Mass and energy balances - Scope of energy auditing in industries - Evaluation of energy conserving opportunities and environmental management - Preparation and presentation of energy audit reports - case studies and potential energy savings.

UNIT - III	Instrumentation	Lecture Hrs: 10

General Audit Instrumentation –Measuring building losses – Applications of IR thermo graphy – Measurement of electrical system performance – Measurement of heating, ventilation, air conditioning system performance – Measurement of combustion systems.

UNIT - IV	Energy conservation	Lecture Hrs:10

Energy conservation in HVAC systems and thermal power plants, Solar systems, Fan and Lighting Systems - Different light sources and luminous efficiency

UNIT - V	Economic evaluation of energy conservation	Lecture Hrs:9

Energy conservation in electrical devices and systems - Economic evaluation of energy conservation measures - Electric motors and transformers - Inverters and UPS - Voltage stabilizers.

Textbooks:

1. Frank kreith and D. Yogi goswamy/ Editors, "Energy Management and conservation handbook". NewYork,2008.
2. WC Turner: Energy Management Handbook, Seventh Edition, (Fairmont Press Inc., 2007)
3. YP Abbi and Shashank Jain: Handbook on Energy Audit and Environment Management, (TERIPress, 2006)

Reference Books:

1. Albert Thumann, and William J. Younger, "Handbook of Energy Audits", Marcel Dekker, Inc., Newyork, 6th edition, 2003.
2. D.A.Reay, Industrial Energy Conservation-Pergamon Press, 1980.
3. T.L.Boten, LiptakB.G.,(Ed)Instrument Engineers Handbook, Chinton Book Company, 2004.
4. Hodge B.K, Analysis and Design of Energy Systems, Prentice Hall, 2002.
5. Larry C.Witte, Schmidt & Brown, Industrial energy management and utilization. Hemisphere publishing, Co.NewYork,1988.

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M.TECH. IN ELECTRICAL POWER SYSTEMS/POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	MODELLING AND ANALYSIS OF HVDC TRANSMISSION SYSTEMS (PE-I)	L	T	P	C
21D49103b		3	0	0	3
	Semester	I			

Course Objectives: To make the student

- To understand the concept, planning of DC power transmission.
- To analyze HVDC converters, Transient and Dynamic Stability.
- To apply modeling of power flow analysis.
- To design digital dynamic simulation of converters and DC systems

Course Outcomes (CO): Student will be able to

- To identify the electrical requirements for HVDC lines.
- Analyze the different modes of operation for six pulse & twelve pulse converter unit in the context of HVDC system.
- Apply the knowledge of HVDC transmission in Power networks.
- Determine the appropriate HVDC transmission line parameters under different physical conditions

UNIT – I	HVDC CONVERTERS AND SYSTEM CONTROL	Lecture Hrs: 10

Analysis of HVDC Converters: Pulse number – choice of converter configuration – simplified analysis of Graetz circuit – converter bridge characteristics.
Converter and HVDC system control: Principles of DC link control – converter control characteristics – system control hierarchy – firing angle control – current and extinction angle control – starting and stopping of DC link power control.

UNIT – II	MODELING FOR POWER FLOW ANALYSIS OF AC/DC SYSTEMS	Lecture Hrs: 9

Modeling of HVDC Components: HVDC Converter model - Converter control - Modeling of DC network - Modeling of AC Network.
Power flow analysis in AC/DC systems: Modeling of DC links –Multi terminal DC links- Solution of DC load flow –per unit system for DC qualities – Solution of AC/DC power flow.

UNIT - III	TRANSIENT AND DYNAMIC STABILITY ANALYSIS	Lecture Hrs: 10

Transient stability Analysis – Converter model – Converter control models – DC network models – solution methodology – Direct methods for stability Evaluation.
Dynamic Stability and power modulation - Power modulation for damping low frequency oscillations – Basic principles – practical consideration in the application of power modulation controllers – Gamma or reactive power modulation – power modulation in MTDC system – voltage stability in AC/DC system.

UNIT – IV	HARMONIC AND TORSIONAL INTERACTIONS	Lecture Hrs: 10

Harmonic and Torsional Interactions: Harmonic Interactions - Torsion Interactions – Torsional interactions with in HVDC systems – counter measures to torsion interactions with DC systems.
Simulation of HVDC systems: System simulation – philosophy & Tools – HVDC system simulation – modeling of HVDC systems Digital dynamic simulation.

UNIT – V	MODELING OF HVDC SYSTEMS	Lecture Hrs: 9

Digital dynamic simulation of converters and DC systems: Valve model, Gate pulse generation – generation of control voltage – transformer model – converter model – transient simulation of DC and AC systems.

Textbooks:

1. K.R. Padiyar, HVDC Power Transmission Systems – Technology & System Interactions, New Age International Publishers, 3rd Edition, 2017
2. S Kamakshaiah and V Kamaraju, HVDC Transmission, Tata Mc Graw Hill, New Delhi, 2nd Edition, 2021.

Reference Books:

1. E.W. Kimbark, Direct current transmission, Wiely Inter Science – New York, 1st Edition, 1971
2. J. Arillaga, HVDC Transmission, Peter Peregrinus Ltd., London UK 2nd Edition, 1998
3. E. Uhlman, Power transmission by direct current, Springer Verlag, Berlin Helberg, 1st Edition, 1985

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M.TECH. IN ELECTRICAL POWER SYSTEMS/POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	POWER SYSTEM OPTIMIZATION (PE-I)	L	T	P	C
21D49103c		3	0	0	3
	Semester	I			

Course Objectives: To make the student

- Understand the fundamental concepts of Optimization Techniques.
- Analyze the importance of optimizations in real life scenarios.
- Apply the concepts of various classical and modern methods for constrained and unconstrained problems in both single and multivariable.
- Design the algorithms for different optimizations techniques

Course Outcomes (CO): Student will be able to

- Understand the concept of optimality criteria for various type of optimization problems.
- Analyze the concept of different optimization techniques in real world applications.
- Solve various constrained and unconstrained problems in single variable as well as multivariable.
- Design the methods of optimization for real life situation.

UNIT – I	**CONVENTIONAL OPTOMIZATION TECHNIQUES & FUNDAMENTALS OF PARTICLE SWARM OPTIMIZATION (PSO) TECHNIQUES**	Lecture Hrs: 10

Concepts & Terms related to Optimization -Quadratic optimization problem - Karush - Kuhn - Tucker (KKT) necessary and sufficient conditions for quadratic programming problem- Interior point method for convex optimization - linear programming.

Background of PSO – Original PSO – Variation of PSO – Discrete PSO – PSO for MINLPs – Constriction Factor Approach (CFA) – Hybrid PSO (HPSO) – L best Model – Adaptive PSO (APSO) Evolutionary PSO (EPSO) – Applications.

UNIT – II	**FUNDAMENTALS OF ANT COLONY SEARCH ALGORITHMS**	Lecture Hrs: 9

Ant Colony Search Algorithm – Behavior of Real Ants – Ant Colony Algorithms – The Ant System – The Ant Colony System – The Max-Min Ant System – Major Characteristics of Ant Colony Search Algorithm – Distributed Computation: Avoid Premature Convergence – Positive Feedback: Rapid Discovery of Good Solution – Use of Greedy Search and Constructive Heuristic Information: Find Acceptable Solutions in the Early Stage of the Process.

UNIT - III	**FUNDAMENTALS OF TABU SEARCH**	Lecture Hrs: 12

Overview of the Tabu Search Approach – Problem Formulation – Coding and Representation – Neighborhood Structure – Characterization of the Neighborhood – Functions and Strategies in Tabu Search – Recency- Based Tabu Search – Basic Tabu Search Algorithm – Candidate List Strategies – Tabu tenure – Aspiration Criteria – The Use of Long Term Memory in Tabu Search – Frequency-Based Memory – Intensification – Diversification – Other TS Strategies – Path Relinking – Strategic Oscillation – Applications of Tabu Search.

UNIT – IV	**APPLICATION TO POWER SYSTEMS**	Lecture Hrs: 9

Introduction to power system applications – Model identifications – Dynamic load modeling – Short term load forecasting – Distribution system applications – Network reconfiguration for loss reduction – Optimal protection and switching devices placements – Examples.

UNIT – V	**POWER SYSTEM CONTROLS**	Lecture Hrs: 9

Overview – Power system controls: Particle Swarm Technique – Problem formulation of VVC – State variables – Problem formulation – Expansion of PSO for MINLP – Voltage security assessment – VVC using PSO – Treatment of state variables – VVC algorithm using PSO – Numerical Examples – IEEE 14 Bus system.

Textbooks:

1. A Ravindran, K.M. Ragsdell, and G.V. Reklaitis, "Engineering optimization : Methods and applications", Wiley India Edition.
2. Kwang Y. Lee and Mohamed A. EI- Sharkawi "Modern Heuristic Optimization Techniques Theory and Applications to Power Systems", A John Wiley & Sons. INC. Publication, 1st edition, 2020
3. D. P. Kothari and J. S. Dhillon, "Power System Optimization", PHI Learning Private Limited, 2nd Edition, 2011.

Reference Books:

1. Jizhong Zhu, "Optimization of power system operation", IEEE Press, John *Wiley* & Sons, Inc., *Publication, 2nd edition, 2015*.
2. Joshua adam Taylor, "Convex optimization of power systems'', Cambridge University Press, 1st edition, 2015.

Online Learning Resources:

https://nptel.ac.in/courses/112/106/112106064/

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ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN ELECTRICAL POWER SYSTEMS/POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	SOLAR & WIND ENERGY CONVERSION SYSTEM (PE-II)	L	T	P	C
21D49104a		3	0	0	3
	Semester	I			

Course Objectives: To make the student

- To introduce photovoltaic systems and principle of wind turbines
- To deal with various technologies of solar PV cells
- To understand details about manufacture, sizing and operating techniques in solar energy conversion systems.
- Understand the concepts of fixed speed and variable speed, wind energy conversion systems.
- To have knowledge of design considerations and analyze grid integration issues.

Course Outcomes (CO): Student will be able to

- Understand the fundamentals of solar cell, Solar PV Modules from solar cells, system types, Standalone PV system configuration, Maximum Power Point tracking (MPPT) and fundamentals the concepts of fixed speed and variable speed, wind energy conversion systems.
- Apply the concept of various technologies of solar PV cells, manufacture, sizing and operating techniques.
- Analyze the concept of Effect of series and shunt resistance on efficiency, Effect of solar radiation on efficiency, Analytical techniques, Hot spots in the module,Algorithms for MPPT and
- Design of PV powered DC fan without battery, Standalone system with DC load using MPPT, PV powered DC pump, standalone system with battery and AC/DC load and control principles of Wind turbine.

UNIT – I	SOLAR & WIND FUNDAMENTALS	Lecture Hrs: 10

Need for sustainable energy sources – solar radiation – the sun and earth movement – angle of sunrays on solar collectors – sun tracking – estimating solar radiation – measurement of solar radiation. Types of wind energy conversion devices – definition - solidity, tip speed ratio, power coefficient, wind turbine ratings and specifications - aerodynamics of wind rotors - design of the wind turbine rotor – Issues due to integration of solar and wind energy systems.

UNIT – II	SOLAR PHOTOVOLTAIC MODULES	Lecture Hrs: 9

Solar PV Modules from solar cells – model of a solar cell, effect of series and shunt resistance on efficiency, effect of solar radiation on efficiency - series and parallel connection of cells – mismatch in module – mismatch in series connection – hot spots in the module, bypass diode – mismatching in parallel diode – design and structure of PV modules – number of solar cells in a module, wattage of modules, fabrication of PV module – PV module power output.

UNIT - III	PV SYSTEM DESIGN AND APPLICATIONS	Lecture Hrs: 10

Introduction to solar PV systems – standalone PV system configuration – design methodology ofPV systems – design of PV powered DC fan without battery, standalone system with DC load using MPPT, design of PV powered DC pump, design of standalone system with battery and AC/DC load – wire sizing in PV system – precise sizing of PV systems – Hybrid PV systems – grid connected PV systems.

UNIT – IV	WIND TURBINE CONTROL SYSTEMS & SITE ANALYSIS	Lecture Hrs: 10

Wind Turbine - Torque speed characteristics - Pitch angle control – stall control – power electronic control – Yaw control – Control strategy – Wind speed measurements – Wind speed statistics – Site and turbine selection. Constant voltage & constant frequency- single output system –double output system with current converter & voltage source inverter – equivalent circuits – reactive power and harmonics - reactive power compensation – variable voltage, variable frequency – the self-excitation process – circuit model for the self-excited induction generator – analysis of steady state operation – the excitation requirement – effect of a wind generator on the network .

UNIT – V	WIND GENERATION WITH VARIABLE SPEED	Lecture Hrs: 11

	TURBINES AND APPLICATIONS	
Classification of schemes – operating area – induction generators – doubly fed induction generator – wound field synchronous generator – the permanent magnet generator – Merits and limitations of wind energy conversion systems – application in hybrid energy systems – diesel generator and photovoltaic systems – wind photovoltaic systems.		

Textbooks:

1. "Solar Photovoltaics Fundamentals, Technologies and Applications" by Chetan singh solanki, PHI publications, 3rd edition, 2015
2. S.N.Bhadra, D.Kastha, S.Banerjee, " wind electrical systems" Oxford University Press, 1st edition, 2013
3. Banshi D. Shukla, "Engineering of Wind Energy", Jain Brothers, 1st edition, 2018

Reference Books:

1. H.P. Garg, J. Prakash, Solar Energy Fundamentals and applications Tata McGraw- Hill publishers 1st edition, 2000
2. S.Rao & B.B.Parulekar, Energy Technology, Khanna publishers, 4th edition, 2005.
3. N.K.Bansal, M. Kleemann,Michael Meliss, Renewable Energy sources & Conversion Technology, Tata Mcgraw Hill Publishers & Co., 1st edition, 1990

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M.TECH. IN ELECTRICAL POWER SYSTEMS/POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	SMART GRID TECHNOLOGIES	L	T	P	C
21D49104b	(PE-II)	3	0	0	3
	Semester	I			

Course Objectives: To make the student

- To know the importance of smart grid technology functions over the present grid.
- To get the knowledge about the measurement system and communication technology of Smart grid.
- To enhance the quality, efficiency and security of power supply.
- To impart an understanding of economics, policies and technical regulations for DG integration.

Course Outcomes (CO): Student will be able to

- Understand the importance of smart grid technology functions over the present grid.
- Apply the knowledge about the measurement system and communication technology of Smart grid.
- Determine the quality, efficiency and security of power supply.
- Impart an understanding of economics, policies and technical regulations for DG integration.

UNIT – I | **SMART GRIDS** | Lecture Hrs: 10

Smart grid overview- ageing assets and lack of circuit capacity- thermal constraints, operational constraints, security of supply- national initiatives- early smart grid initiatives- active distribution networks- virtual power plant- other initiatives and demonstrations- overview of the technologies required for the smart grid.

UNIT – II | **TRANSMISSION AND DISTRIBUTION MANAGEMENT** | Lecture Hrs: 10

Data Sources- Energy Management System-Wide Area Applications, Visualization Techniques- Data Sources and Associated External Systems- SCADA- Customer Information System- Modeling and Analysis Tools, Distribution System Modeling- Topology Analysis- Load Forecasting- Power Flow Analysis- Fault Calculations- State Estimation- Applications-System Monitoring- Operation- Management- Outage Management System- Overview of energy storage technologies.

UNIT - III | **SMART METERING AND DEMAND SIDE INTEGRATION** | Lecture Hrs: 11

Overview- Smart metering – Evolution of electricity metering- key components of smart metering- smart meters: an overview of the hardware used – signal acquisition- signal conditioning-analogue to digital conversion-computation-input/output and communication. Communication infrastructure and protocols for smart metering - Home area network, Neighborhood Area Network- Data Concentrator- meter data management system- Protocols for communication. Demand Side Integration- Services Provided by DSI-Implementation of DSI- Hardware Support- Flexibility Delivered by consumers from the Demand Side- System Support from DSI.

UNIT – IV | **COMMUNICATION TECHNOLOGIES FOR THE SMART GRID** | Lecture Hrs: 10

Data Communications: Dedicated and Shared Communication Channels, Switching Techniques, Circuit Switching, Message Switching, Packet Switching- Communication Channels, Introduction to TCP/IP.
Communication Technologies: IEEE 802 Series- Mobile Communications- Multi-Protocol Label Switching- Power line Communication.

UNIT – V | **INFORMATION SECURITY FOR THE SMART GRID** | Lecture Hrs: 10

Overview- Encryption and Decryption, Symmetric Key Encryption- Public Key Encryption- Authentication- Authentication Based on Shared Secret Key- Authentication Based on Key Distribution Center- Digital Signatures- Secret Key Signature-Public Key Signature- Message Digest.

Textbooks:

1. Janaka Ekanayake, Kithsiri Liyanage, et.al., Smart Grid Technology and Applications, Wiley Publications, 1st edition, 2012.
2. James Momoh, Smart Grid: Fundamentals of Design and Analysis, Wiley, IEEE Press, 1st edition, 2012.
3. Bharat Modi, Anuprakash, Yogesh Kumar, Fundamentals of Smart Grid Technology, S.K Kataria& Sons, 1st edition, 2019.

Reference Books:
1. Eric D. Knapp, Raj Samani, Applied Cyber Security and the Smart Grid-Implementing Security Controls into the Modern Power Infrastructure, Syngress Publishers, 1st edition, 2013. 2. Nouredine Hadjsaid, Jean Claude Sabonnadiere, Smart Grids, Wiley Blackwell Publications, 1st edition, 2012. 3. Peter-Fox Penner, Smart Power: Climate Changes, the Smart Grid and the future of electric utilities, Island Press, 1st edition, 2010.
Online Learning Resources:
www.indiasmartgrid.org

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M.TECH. IN ELECTRICAL POWER SYSTEMS/POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	**ELECTRIC VEHICLE ENGINEERING (PE-II)**	**L**	**T**	**P**	**C**
21D49104c		**3**	**0**	**0**	**3**
	Semester	**I**			

Course Objectives: To make the student

- Remember and Understand the differences between conventional Vehicle and Electric Vehicles, electro mobility and environmental issues of EVs.
- Analyze various EV configurations, parameters of EV systems and Electric vehicle dynamics.
- Analyze the basic construction, operation and characteristics of fuel cells and battery charging techniques in HEV systems.
- Design and analyze the various control structures for Electric vehicle

Course Outcomes (CO): Student will be able to

- To understand and differentiate between Conventional Vehicle and Electric Vehicles, electro mobility and environmental issues of EVs.
- To remember and understand various configurations in parameters of EV system and dynamic aspects of EV.
- To analyze fuel cell technologies in EV and HEV systems.
- To analyze the battery charging and controls required of EVs.

UNIT – I	**Introduction to EV Systems and Energy Sources**	Lecture Hrs: 10

Past, Present and Future of EV - EV Concept- EV Technology- State-of-the Art of EVs- EV configuration- EV system- Fixed and Variable gearing- Single and multiple motor drive- In-wheel drives- EV parameters: Weight, size, force and energy, performance parameters.
Electro mobility and the environment- History of Electric power trains- Carbon emissions from fuels- Green houses and pollutants- Comparison of conventional, battery, hybrid and fuel cell electric systems.

UNIT – II	**EV Propulsion and Dynamics**	Lecture Hrs: 10

Choice of electric propulsion system- Block diagram- Concept of EV Motors- Single and multi motor configurations- Fixed and variable geared transmission- In-wheel motor configuration- Classification- Electric motors used in current vehicle applications- Recent EV Motors- Vehicle load factors- Vehicle acceleration.

UNIT - III	**Fuel Cells**	Lecture Hrs: 10

Introduction of fuel cells- Basic operation- Model - Voltage, power and efficiency- Power plant system – Characteristics- Sizing - Example of fuel cell electric vehicle.
Introduction to HEV- Brake specific fuel consumption - Comparison of Series-Parallel hybrid systems- Examples.

UNIT – IV	**Battery Charging and Control**	Lecture Hrs: 12

Battery charging: Basic requirements- Charger architecture- Charger functions- Wireless charging- Power factor correction.
Control: Introduction- Modeling of electro mechanical system- Feedback controller design approach- PI controllers designing- Torque-loop, Speed control loop compensation- Acceleration of battery electric vehicle.

UNIT – V	**Energy Storage Technologies**	Lecture Hrs: 10

Role of Energy Storage Systems- Thermal- Mechanical-Chemical- Electrochemical- Electrical - Efficiency of energy storage systems- Super capacitors-Superconducting Magnetic Energy Storage (SMES)- SoC- SoH -fuel cells - G2V- V2G- Energy storage in Micro-grid and Smart grid- Energy

Management with storage systems- Hybrid energy storage systems -Battery SCADA

Textbooks:

1. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001,1st Edition
2. Francisco Díaz-González, Andreas Sumper, Oriol Gomis-Bellmunt,” Energy Storage in Power Systems” Wiley Publication, ISBN: 978-1-118-97130-7, Mar 2016,1st Edition

Reference Books:

1. Electric and Hybrid Vehicles Design Fundamentals, Iqbal Husain, CRC Press 2021,3rd Edition.
2. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2015,1st Edition
3. A.G.Ter-Gazarian, “Energy Storage for Power Systems”, the Institution of Engineering and Technology (IET) Publication, UK, (ISBN – 978-1-84919-219-4), Second Edition, 2011.
3. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, “Modern Elelctric, Hybrid Elelctric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 2004,1st Edition
4. James Larminie, John Lowry, “Electric Vehicle Technology Explained”, Wiley, 2003,2nd Edition.

Online Learning Resources:

1. https://nptel.ac.in/courses/108/102/108102121/
2. https://nptel.ac.in/syllabus/108103009

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M.TECH. IN ELECTRICAL POWER SYSTEMS/POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	**MACHINES & POWER SYSTEMS LAB**	**L**	**T**	**P**	**C**
21D49105		**0**	**0**	**4**	**2**
	Semester	**I**			

Course Objectives: To make the student

- Understand the experiments ensuring the safety of equipment and personnel.
- Analyze the power system data fault studies.
- Interpret the experimental results and correlating them with the practical power system.
- Design the relays for power system protection purpose.

Course Outcomes (CO): Student will be able to

- Understand the concept of different experiments.
- Analyze the data for and compute the data to obtain results.
- Apply the computational results to solve the original power system problems.
- Develop advanced relays to identify various faults.

List of Experiments:

1. Determination of Subtransient Reactance of a Salient Pole Machine
2. Determination of Sequence Impedances of a Cylindrical Rotor Synchronous Machine
3. Fault Analysis
   i) LG Fault
   ii) LL Fault
   iii) LLG Fault
   iv) LLLG Fault
4. Equivalent Circuit of a Three Winding Transformer
5. Separation of No Load losses of a Three Phase Squirrel Cage Induction Motor
6. Power Angle Characteristics of a Salient Pole Synchronous Machine
7. Characteristics of Static/Numeric Over Current Relay
8. Characteristics of Static Negative Sequence Relay
9. Characteristics of Static/Numeric Over Voltage Relay
10. Characteristics of Static/Numeric Percentage Biased Differential Relay
11. Testing of Buchholz relay
12. Testing of Frequency Relay.
13. Testing of Reverse Power Relay.
14. Testing of Earth fault Relay

Web Sources: https://www.vlab.co.in

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M.TECH. IN ELECTRICAL POWER SYSTEMS / POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	**POWER SYSTEMS SIMULATION LAB**	**L**	**T**	**P**	**C**
21D49106		**0**	**0**	**4**	**2**
	Semester	**I**			

Course Objectives: To make the student

- Understand how to write the coding in simulation
- Analyze the data related to load flows, economic dispatch problem and transient stability analysis.
- Apply the computational results in real life power system problems.
- Have the capabilities to develop new software's to optimize the results.

Course Outcomes (CO): Student will be able to

- Understand the coding in simulation
- Analyze the power system data for load-flow and stability studies.
- Apply computational methods for large scale power system studies.
- Develop software for power system industry to solve various issues.

List of Experiments:

1. Y - Bus Formation
2. Gauss – Seidel Load Flow Analysis
3. Fast Decoupled Load Flow Analysis
4. Fast Decoupled Load Flow Analysis for Distribution Systems
5. Point by Point Method
6. Computation of Available Transfer Capabilities.
7. Contingency analysis.
8. State estimation using Weighted Least Square, linear and non-linear methods.
9. Simulation of power quality problems (Sag/Swell, interruption, transients, harmonics, flickers etc.)
10. Harmonic analysis and Single tuned filter design to mitigate harmonics.
11. Harmonic analysis and Double tuned filter design to mitigate harmonics.

Web Sources: https://www.vlab.co.in

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M.TECH. IN ELECTRICAL POWER SYSTEMS/POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	**RESEARCH METHODOLOGY AND IPR**	**L**	**T**	**P**	**C**
21DRM101		**2**	**0**	**0**	**2**
	Semester			**I**	

Course Objectives:

- Identify an appropriate research problem in their interesting domain.
- Understand ethical issues understand the Preparation of a research project thesis report.
- Understand the Preparation of a research project thesis report
- Understand the law of patent and copyrights.
- Understand the Adequate knowledge on IPR

Course Outcomes (CO): Student will be able to

- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT - I		Lecture Hrs:

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, scope, and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT - II		Lecture Hrs:

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT - III		Lecture Hrs:

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT - IV		Lecture Hrs:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT - V		

Textbooks:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

Reference Books:

1. 1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for
2. beginners"
3. 2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
4. 3. Mayall, "Industrial Design", McGraw Hill, 1992.
5. 4. Niebel, "Product Design", McGraw Hill, 1974.
6. 5. Asimov, "Introduction to Design", Prentice Hall, 1962.
7. 6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New
8. Technological Age", 2016.

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M.TECH. IN ELECTRICAL POWER SYSTEMS / POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	POWER SYSTEM STABILITY & CONTROL	L	T	P	C
21D49201		3	0	0	3
	Semester	II			

Course Objectives: To make the student

- Understand about linear and nonlinear models of multi-machine power systems.
- Analyze various types of stability properties of power systems.
- Identify power system models from dynamic data and simulate excitation mechanisms in synchronous machines.
- Design excitation systems and their state space model equations for further stability applications.

Course Outcomes (CO): Student will be able to

- Understand the concepts of single and multi-machine systems connected to infinite bus bar.
- Analyze system responses to small disturbances and concept of dynamic stability and power system stabilizers.
- Apply the various stability methods to evaluate the stability of the system.
- Design the state space model equations for excitation systems and methods for finding voltage and angle instability.

UNIT - I	THE ELEMENTARY MATHEMATICAL MODEL	Lecture Hrs: 10

Introduction to equal area criteria – Power Angle curve of a Synchronous Machine – Model of single machine connected to an infinite bus – Model of multimachine system – Problems – Classical Stability Study of multimachine system – Effect of the excitation system on Transient stability.

UNIT - II	SYSTEM RESPONSE TO SMALL DISTURBANCES AND DYNAMIC STABILITY	Lecture Hrs: 8

The unregulated synchronous Machine – Modes of oscillation of an unregulated multimachine system – Regulated synchronous machine – Voltage regulator with one time lag – Governor withone time lag – Problems - Concept of Dynamic stability – State-space model of single machine system connected to infinite bus – Effect of excitation on Dynamic stability – Examination of dynamic stability by Routh-Hurwitz criterions.

UNIT - III	POWER SYSTEM STABILIZERS	Lecture Hrs: 12

Introduction to supplementary stabilizing signals – Block diagram of the linear system – Approximate model of the complete exciter – Generator system – Lead compensation – Stability analysis using eigen value approach.

UNIT - IV	EXCITATION SYSTEMS	Lecture Hrs:12

Introduction to excitation systems – Non-continuously, Continuously regulated systems – Excitation system compensation – State-space description of the excitation system – Simplified linear model – Effect of excitation on generator power limits. Type-2, Type-3 and Type-4 excitation systems and their state-space modeling equations.

UNIT - V	STABILITY ANALYSIS	Lecture Hrs:10

Review of Lyapunov's stability of non-liner systems using energy concept – Method based on first concept – Method based on first integrals – Zubov's method – Popov's method – Lyapunov function for single machine connected to infinite bus – Voltage stability – Factors affecting voltage instability and collapse – Comparison of Angle and Voltage stability – Analysis of voltage instability and collapse – Control of voltage instability.

Textbooks:

1. Vijay Vittal, James D. McCalley, Paul M. Anderson "Power System Control and Stability", Jhon Willey and Sons, 3rd edition, 2019.
2. **Prabha Kundur**, "Power System Control and Stability", McGraw Hill Education India, 1st edition, 5th reprint, 2008.

Reference Books:

1. Dr Jan Machowski, Dr Janusz W. Bialek, Dr Jim Bumby · "Power System Dyanmics: Stability and Control", Jhon willey and Sons, 2nd Edition, 2011.
2. M.A.Pai, Power System Stability-Analysis by the direct method of Lyapunov, North HollandPublishing Company, New York, 1st edition,1981.

Online Learning Resources:

1. https://nptel.ac.in/courses/108/105/108105133/

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M.TECH. IN ELECTRICAL POWER SYSTEMS / POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	FACTS CONTROLLERS	L	T	P	C
21D49202		3	0	0	3
	Semester	II			

Course Objectives: To make the student

- To understand the fundamentals of FACTS Controllers, Importance of controllable parameters and types of FACTS controllers & their benefits
- To explain control of STATCOM and SVC and their comparison and the regulation of STATCOM
- To remember the objectives of Shunt and Series compensation
- To analyze the functioning and control of GCSC, TSSC and TCSC

Course Outcomes (CO): Student will be able to

- Understand various control techniques for the purpose of identifying the scope and for selection of specific FACTS controllers.
- Remember different types of controllable VAR generation and variable impedance techniques.
- Design simple converters using FACTS controllers.
- Understand the operation of Unified Power Controller and Hybrid Arrangements.

UNIT - I	FACTS CONCEPTS, VSI AND CSI	Lecture Hrs: 10

Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters basic types of FACTS controllers, benefits fromFACTS controllers. Single phase three phase full wave bridge converters transformer connections for 12 pulse 24 and 48 pulse operation. Three level voltage source converter, pulse width modulation converter, basic concept of current source Converters, and comparison of current source converters with voltage source converters.

UNIT - II	SHUNT COMPENSATION	Lecture Hrs: 8

Objectives of shunt compensation - Methods of controllable var generation - Variable impedance type static var generators - switching converter type var generators - hybrid var generators – Comparison of SVC and STATCOM.

UNIT - III	SERIES COMPENSATION	Lecture Hrs: 12

Objectives of series compensation – GTO Thyristor Controlled Series Capacitor (GCSC) - Thyristor Switched Series Capacitor (TSSC) - Thyristor Controlled Series Capacitor (TCSC) - Control schemes for TCSC, TSSC and TCSC.

UNIT - IV	UNIFIED POWER FLOW CONTROLLER (UPFC)	Lecture Hrs:12

Introduction - The Unified Power Flow Controller - Basic Operating Principles - Conventional Transmission Control Capabilities - Independent Real and Reactive Power Flow Control - Control Structure - Basic Control System for P and Q Control - Hybrid Arrangements: UPFC With a Phase Shifting Transformer.

UNIT - V	INTERLINE POWER FLOW CONTROLLER (IPFC)	Lecture Hrs:10

Introduction, basic operating principle and characteristics of IPFC, control structure, practical and application considerations, generalized and multifunctional fact controllers

Textbooks:

1. Understanding FACTS – Concepts and technology of Flexible AC Transmission systems, Narain G. Hingorani, Laszlo Gyugyi, IEEE Press, WILEY, 1st Edition, 2000, Reprint 2015.
2. FACTS Controllers in Power Transmission and Distribution, Padiyar K.R., New Age International Publishers, 1st Edition, 2007.

Reference Books:

1. Flexible AC Transmission Systems: Modelling and Control, Xiao – Ping Zhang, Christian Rehtanz, Bikash Pal, Springer, 2012, First Indian Reprint, 2015.
2. FACTS – Modelling and Simulation in Power Networks, Enrigue Acha, Claudio R. Fuerte –

Esquival, Huge Ambriz – perez, Cesar Angeles – Camacho, WILEY, 1st edition, 2004

Course Code	**POWER SYSTEM WIDE AREA MONITORING AND CONTROL (PE – III)**	**L**	**T**	**P**	**C**
21D49203a		**3**	**0**	**0**	**3**
	Semester	**II**			

Course Objectives: To make the student

- To know the necessity of real-time computer control of power systems and wide area measurement system.
- To get the knowledge of different automation systems.
- To know the complete fundamentals of SCADA and its importance in real time powersystems.
- To get the knowledge about Substation Automation, New Digital Substation and traditional approach and IED-based approach of Integrated Protective Functions.
- To study about Voltage stability, prevention of voltage collapse and dynamic stabilityanalysis.

Course Outcomes (CO): Student will be able to

- Know the necessity of real-time computer control of power systems and wide area measurement system.
- Get the knowledge of different automation systems.
- Know the complete fundamentals of SCADA and its importance in real time powersystems.
- Get the knowledge about Substation Automation, New Digital Substation and traditional approach and IED-based approach of Integrated Protective Functions.
- Study about Voltage stability, prevention of voltage collapse and dynamic stabilityanalysis.

UNIT - I	**COMPUTER CONTROL OF POWER SYSTEMS**	Lecture Hrs: 10

Need for computer control of power systems, Operating states of a power system, Supervisory Control and Data Acquisition system, Energy control centers. Wide Area Measurement system (WAMS): Architecture, Components of WAMS, Applications: Voltage Stability Assessment, Frequency stability Assessment, Power Oscillation Assessment, Communication needs of WAMS, Wide Area Monitoring Protection & Control, and Remedial Action Scheme.

UNIT - II	**POWER SYSTEM AUTOMATION**	Lecture Hrs: 8

Introduction, Evolution of Automation Systems, History of Automation Systems, Supervisory Control and Data Acquisition (SCADA) Systems, Components of SCADA Systems, SCADA Applications, SCADA in Power Systems, SCADA Basic Functions, SCADA Application Functions, Advantages of SCADA in Power Systems, Deferred Capital Expenditure, Optimized Operation and Maintenance Costs, Equipment Condition Monitoring (ECM), Sequence of Events (SOE) Recording, Power Quality Improvement, Data Warehousing for Power Utilities, Power System Field, Transmission and Distribution Systems, Customer Premises, Types of Data and Signals in Power Systems, Flow of Data from the Field to the SCADA Control Center

UNIT - III	**SCADA FUNDAMENTALS**	Lecture Hrs: 12

Introduction, Open System: Need and Advantages, Building Blocks of SCADA Systems, Remote Terminal Unit (RTU), Evolution of RTUs, Components of RTU, Communication Subsystem, Logic Subsystem Termination Subsystem, Testing and Human-Machine Interface (HMI) Subsystem, Power Supplies, Advanced RTU Functionalities, Intelligent Electronic Devices (IEDs), Evolution of IEDs, IED Functional Block Diagram, Hardware and Software Architecture of the IED, IED Communication Subsystem, IED Advanced Functionalities, Tools for Settings, Commissioning, and Testing, Programmable LCD Display, Typical IEDs, Data Concentrators and Merging Units, RTUs, IEDs, and Data Concentrator, Merging Units andIEDs.

UNIT - IV	**SUBSTATION AUTOMATION**	Lecture Hrs:12

Substation Automation: Technical Issues, System Responsibilities, System Architecture, Substation Host Processor, Substation LAN, User Interface, Communications Interfaces, Protocol Considerations. The New Digital Substation, Process Level, Protection and Control Level, Station Bus and Station Level, Substation

Automation Architectures, Legacy Substation Automation System, Digital Substation Automation Design, New versus Existing Substations. Drivers of Transition, Migration Paths and the Steps Involved, Value of Standards in Substation Automation, Substation Automation (SA) Application Functions, Integrated Protection Functions: Traditional Approach and IED-Based Approach. Automation Functions, Enterprise- Level Application Functions.

UNIT - V	**VOLTAGE STABILITY**	Lecture Hrs:10

Basic concepts, Voltage collapse – general characterization, classification, Voltage stability analysis – modeling, dynamic analysis, static analysis, shortest distance to instability, continuation power flow analysis, prevention of voltage collapse – design measures, operating measures.

Textbooks:

1. Allen J. Wood and Bruce Woolenberg, Power System Generation, Operation and Control, John Wiley and Sons, 3rd edition, 2013.
2. **Prabha Kundur**, "Power System Control and Stability", McGraw Hill Education India, 1st edition, 5th reprint, 2008.
3. Mini S. Thomas and John Douglas McDonald, Power System SCADA and Smart Grids,CRC Press, 1st edition, 2015.

Reference Books:

1. E. Handschin, Real-time Control of Electrical Power Systems, Elsevier Publications & Co, 1st edition,1988.
2. Special Issue on Computer Control of Power Systems, IEEE Proc, July 1974.

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ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN ELECTRICAL POWER SYSTEMS / POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	MODERN CONTROL THEORY	L	T	P	C
21D49203b	(PE-III)	3	0	0	3
	Semester	II			

Course Objectives: To make the student

- Remember and understand the concept of state space representation, Solution of state equation, STM, linearization of nonlinear systems, controllability and observability concepts, principles of duality, concepts of optimal and Lyapunov stability.
- Apply the above concepts to analyze controllability, Observability and pole placement by state feedback
- Analyze the concept of regulator, stability and sensitivity using various methods and disturbance rejection
- Design Full order observer and reduced order observer.

Course Outcomes (CO): Student will be able to

- Understand the state space representation, controllability and observability concepts, principles of duality, concepts of optimal and Lyapunov stability.
- Apply the state equations, pole placement by state feedback.
- Analyze controllability & observability of state models.
- Design full order observer and reduced order observer.

UNIT - I	STATE VARIABLE DISCRIPTION	Lecture Hrs: 10

Introductory matrix algebra and linear Vector Space, State space representation of systems- Linearization of a non-linear System- Solution of state equations- Evaluation of State Transition Matrix (STM).

UNIT - II	TRANSFORMATION, POLEPLACEMENT AND CONTROLLABILITY	Lecture Hrs: 8

Similarity transformation and invariance of system properties due to similarity transformations. Minimal realization of SISO, SIMO and MISO transfer functions. Discretization of a continuous time state space model-Conversion of state space model to transfer function model using Fadeeva algorithm- Fundamental theorem of feedback control - Controllability and Controllable canonical form - Pole assignment by state feedback using Ackermann‘s formula– Eigen structure assignment problem.

UNIT - III	OPTIMAL CONTROL	Lecture Hrs: 12

Linear Quadratic Regulator (LQR) problem and solution of algebraic Riccati equation using Eigen value and Eigen vector methods- iterative method- Controller design using output feedback.

UNIT - IV	OBSERVERS	Lecture Hrs:12

Observability and observable canonical form-Design of full order observer using Ackermann‘s formula -Bass Gura algorithm- Duality between controllability and observability- Full order Observer based controller design-Reduced order observer design.

UNIT - V	STABILITY ANALYSIS AND SENSITIVITY	Lecture Hrs:10

Internal stability of a system- Stability in the sense of Lyapunov- Asymptotic stability of linear time invariant continuous and discrete time systems- Solution of Lyapunov type equation- Model decomposition and decoupling by state feedback- Disturbance rejection- sensitivity and complementary sensitivity functions.

Textbooks:

1. K. Ogata, “Modern Control Engineering”, Prentice Hall, India, 5th edition, 2010.
2. T. Kailath, ”Linear Systems”, Prentice Hall, 2016.
3. N.K. Sinha, “Control Systems”, New Age International, 4th edition, 2013.

Reference Books:

1. Panos J Antsaklis, and Anthony N.Michel,”LinearSystems”, New-age international (P) LTD.Publishers, 2009.

2. John JD Azzoand C. H. Houpis, "Linear Control System Analysis and Design conventional and Modern", Mc Graw- Hill Book Company, 3rd edition, 1988.
3. B.N.Dutta, "Numerical Methods for linear Control Systems", Elsevier Publication, 2007.
4. C.T. Chen "Linear System Theory and Design-PHI, India,1984.
5. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", 11th Edition, Pearson Edu., India, 2009

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M.TECH. IN ELECTRICAL POWER SYSTEMS / POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	REACTIVE POWER COMPENSATION & MANAGEMENT (PE– III)	L	T	P	C
21D49203c		3	0	0	3
	Semester	II			

Course Objectives: To make the student

- To identify the necessity of reactive power compensation
- To describe load compensation and various types of reactive power compensation in transmission systems
- To illustrate reactive power coordination system
- To characterize distribution side and utility side reactive power management.

Course Outcomes (CO): Student will be able to

- Understand the importance of load compensation in symmetrical as well as unsymmetrical loads
- Analyze various compensation methods in transmission lines
- Design model for reactive power coordination
- Distinguish demand side reactive power management & user side reactive power management

UNIT - I	LOAD COMPENSATION	Lecture Hrs: 10

Objectives and specifications – Reactive power characteristics – Inductive and capacitive approximate biasing – Load compensator as a voltage regulator – Phase balancing and power factor correction of unsymmetrical loads - Examples.

UNIT - II	STEADY STATE & TRANSIENT STATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEM	Lecture Hrs: 8

Uncompensated line – Types of compensation – Passive shunt and series and dynamic shunt compensation – Characteristic time periods – Passive shunt compensation – Static compensation-Series capacitor compensation – Compensation using synchronous condensers –Examples.

UNIT - III	REACTIVE POWER COORDINATION & DEMAND SIDE MANAGEMENT	Lecture Hrs: 12

Objective – Mathematical modeling – Operation planning – Transmission benefits – Basic concepts of quality of power supply – Disturbances - Steady – state variations – Effects of under Voltages – Frequency – Harmonics, radio frequency and electromagnetic interferences. Load patterns – Basic methods - load shaping – Power tariffs - KVAR based tariffs - penalties for voltage flickers and Harmonic voltage levels.

UNIT - IV	DISTRIBUTION & USER SIDE REACTIVE POWER MANAGEMENT	Lecture Hrs:12

System losses – Loss reduction methods – Examples – Reactive power planning – Objectives – Economics - Planning capacitor placement – Retrofitting of capacitor banks - KVAR requirements for domestic appliances – Purpose of using capacitors – Selection of capacitors – Deciding factors – Types of capacitors, characteristics and Limitations.

UNIT - V	REACTIVE POWER MANAGEMENT IN ELECTRIC TRACTION SYSTEMS AND ARC FURNACES	Lecture Hrs:10

Typical layout of traction systems – Reactive power control requirements – Distribution transformers - Electric arc furnaces – Furnaces transformer – Filter requirements – Remedial measures – Power factor of an arc furnace.

Textbooks:

1. T.J.E.Miller, "Reactive Power Control in Electric Systems", John Wiley and Sons, 5th edition, 2017. 2. D.M.Tagare, Reactive power Management, Tata Mc Graw Hill, 1st edition, 2004.
Reference Books:
1. Dr. Hidaia alassouli, "Reactive Power Compensation", Kindle Edition.2018. 2. Wolfgang Hofmann, Jurgen Schlabbach, Wolfgang Just "Reactive Power Compensation: A Practical Guide, Wiely publication, 4th edition, April, 2012.

Course Code	POWER QUALITY	L	T	P	C
21D49204a	(PE- IV)	3	0	0	3
	Semester	II			

Course Objectives: To make the student

- To understand power quality definition, power quality standards.
- To remember measuring & solving power quality problems.
- To apply the various types of linear and nonlinear loads
- To analyse harmonic methodology, mitigation techniques and case study

Course Outcomes (CO): Student will be able to

- Understand the fundamentals & terminology of power quality.
- Apply the concept of power frequency disturbances, types of transients & transient waveforms.
- Analyze the harmonic methodology & Electromagnetic Interference concepts.
- Remember the necessity of grounding and methods of grounding.
- Understand different techniques of measuring & solving power quality problems

UNIT - I	INTRODUCTION TO POWERQUALITY	Lecture Hrs: 10

Definition of Power Quality - Power Quality Progression - Power Quality Terminology - Power Quality Issues–Responsibilities of Power Suppliers and Users-Power Quality Standards.

UNIT - II	POWER FREQUENCY DISTURBANCE&TRANSIENTS	Lecture Hrs: 8

Introduction to Power Frequency Disturbance - Common Power Frequency Disturbances – Characteristics of Low Frequency Disturbances - Voltage Tolerance Criteria- ITIC Graph - Introduction to Transients -Transient System Model - Examples of Transient Models and Their Response - Power System Transient Modeling-Types and Causes of Transients -Examples of Transient Waveforms.

UNIT - III	HARMONICS & ELECTROMAGNETIC INTERFERENCE (EMI)	Lecture Hrs: 12

Definition of Harmonics - Harmonic Number (h) - Odd and Even Order Harmonics - Harmonic Phase Rotation and Phase Angle - Voltage and Current Harmonics - Individual and Total Harmonic Distortion -Harmonic Signatures - Effect of Harmonics On Power System Devices - Guidelines For Harmonic Voltage and Current Limitation - Harmonic Current Mitigation - Introduction to EMI - Frequency Classification –Electrical Fields-Magnetic Fields-EMI Terminology-Power Frequency Fields-High Frequency Interference-EMI Susceptibility-EMI Mitigation-Cable Shielding-Health Concerns of EMI.

UNIT - IV	GROUNDINGANDBONDING	Lecture Hrs:12

Introduction to Grounding and Bonding-Shock and Fire Hazards-NEC Grounding Requirements-Essentials of a Grounded System-Ground Electrodes-Earth Resistance Tests-Earth Ground Grid Systems-Power Ground System-Signal Reference Ground(SRG)-SRG Methods-Single and Multipoint Grounding –Ground Loops –Electro chemical Reaction -Examples of Grounding Anomalies.

UNIT - V	MEASURING AND SOLVING POWER QUALITY PROBLEMS	Lecture Hrs:10

Introduction to Power Quality Measurements-Power Quality Measurement Devices-Power Quality Measurements Test Locations-Test Duration-Instrument Setup- Instrument Guidelines – Power quality mitigating concepts and devices .

Textbooks:

1. Power quality by C. Sankaran, CRC Press, 1st Edition, 2001
2. Electrical Power Systems Quality, Roger C. Dugan, Mark F. Mc Granaghan, Surya Santoso, H. Wayne Beaty, 2nd Edition, TMH Education Pvt. Ltd, 1996.

Reference Books:

1. Understanding Power quality problems by Math H. J.Bollen IEEE Press, 1st edition, 2000.
2. Power quality enhancement using custom power devices by Arindam, Ghosh, Gerard Ledwich, Kluwer, Academic publishers, 1st edition, 2002.

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M.TECH. IN ELECTRICAL POWER SYSTEMS / POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	DISTRIBUTED GENERATION & MICROGRID CONTROL (PE– IV)	L	T	P	C
21D49204b		3	0	0	3
	Semester	II			

Course Objectives: To make the student

- Able to know about the concept of distributed generation, distribution network & the concept of Microgrid, its configuration, advantages & limitations.
- Able to understand the basic concepts in combined heat and power, Wind energy conversion systems, solar photovoltaic systems & other renewable energy sources.
- Able to analyze the impact of Microgrid & Active distribution network management system on various factors.
- Able to know the effect of SCADA & understand the concept of Power quality disturbances, improvement technologies & issues of premium power in DC integration.

Course Outcomes (CO): Student will be able to

- Understand the concept of distributed generation, distribution network & the concept of Microgrid, its configuration, advantages & limitations.
- Understand the basic concepts in combined heat and power, Wind energy conversion systems, Solar photovoltaic systems & other renewable energy sources.
- The impact of Microgrid & Active distribution network management system on various factors isknown.
- Understand the effect of SCADA & understand the concept of Power quality disturbances, improvement technologies & issues of premium power in DC integration.

UNIT - I	INTRODUCTION TO DISTRIBUTED GENERATION AND MICROGRIDCONCEPT	Lecture Hrs: 10

Introduction to distributed generation - Active distribution network - Concept of Microgrid - Microgrid configuration - Interconnection of Microgrids - Technical and economical advantages of Microgrid - Challenges and limitations of Microgrid development - Management and operational issues of a Microgrid - Dynamic interactions of Microgrid with main grid – low voltage DC grid.

UNIT - II	DISTRIBUTED ENERGY RESOURCES	Lecture Hrs: 8

Introduction - Combined heat and power (CHP) systems: Micro-CHP systems - Wind energy conversion systems (WECS): Wind turbine operating systems - Solar photovoltaic (PV) systems: Classification of PV cell - Small-scale hydroelectric power generation - Other renewable energy sources - Storage devices.

UNIT - III	MICROGRID AND ACTIVE DISTRIBUTION NETWORK MANAGEMENTSYSTEM	Lecture Hrs: 12

Introduction - Impact on heat utilization - Impact on process optimisation - Impact on market - Impact on environment - Impact on distribution system - Impact on communication standards and protocols - Network management needs of Microgrid - Microsource controller - Central controller.

UNIT - IV	SCADA AND ACTIVE DISTRIBUTION NETWORKS	Lecture Hrs:12

Introduction - Existing DNO SCADA systems - Control of DNO SCADA systems - SCADA in Microgrids - Human–machine interface (HMI) - Hardware components - Communication trends in SCADA - Distributed control system (DCS) - Sub-station communication standardization - SCADA communication and control architectures - Communication devices.

UNIT - V	IMPACT OF DG INTEGRATION ON POWER QUALITY AND RELIABILITY	Lecture Hrs:10

Introduction - Power quality disturbances - Power quality sensitive customers - Power quality improvement technologies - Impact of DG integration - Issues of premium power in DG integration.

Textbooks:
1. S. Chowdhury, S.P. Chowdhury and P. Crossley, "Microgrids and Active Distribution Networks", The Institution of Engineering and Technology, 2009. 2. Rajeev Kumar Chuahan, Kalpana Chuahan, "Distributed Energy Resources in Microgrids: Integration, Chalenges and Optimization", Academic Press, 1st Edition, 2019
Reference Books:
1. Magdi S. Mahmoud, "MICROGRID Advanced Control Methods and Renewable Energy System Integration", Joc Hayton, 1st Edition, 2016.

Course Code	EHVAC TRANSMISSION	L	T	P	C
21D49204c	(PE-IV)	3	0	0	3
	Semester	II			

Course Objectives: To make the student

- To understand the basic concepts of EHVAC
- To Identify the factors affecting AC-DC transmission
- To analyze travelling waves and the effects of corona like audible noise
- To estimate field intensity at any point in EHV system with the help of different computational method

Course Outcomes (CO): Student will be able to

- Understand the basic concepts of EHVAC
- Identify the factors affecting AC-DC transmission
- Analyze travelling waves and the effects of corona like audible noise
- Estimate field intensity at any point in EHV system with the help of different computational method.

UNIT - I	PRELIMINARIES	Lecture Hrs: 10

Necessity of EHV AC transmission – Advantages and problems – Power handling capacity and line losses- Mechanical considerations – Resistance of conductors – Properties of bundled conductors – Bundle spacing and bundle radius - Examples.

UNIT - II	LINE AND GROUND REACTIVE PARAMETERS	Lecture Hrs: 8

Line inductance and capacitances – Sequence inductances and capacitances – Modes of propagation – Ground return – Examples. Electrostatics – Field of sphere gap – Field of line changes and properties – Charge – potential relations for multi-conductors – Surface voltage gradient on conductors – Distribution of voltage gradient on sub-conductors of bundle – Examples.

UNIT - III	CORONA EFFECTS	Lecture Hrs: 12

Power loss and audible noise (AN) – corona loss formulae – Charge voltage diagram – Generation, characteristics - Limits and measurements of AN – Relation between 1-phase and 3 -phase AN levels – Radio interference (RI) - Corona pulses generation, properties, limits – Frequency spectrum – Modes of propagation – Excitation function – Measurement of RI, RIV and excitation functions - Examples.

UNIT - IV	ELECTROSTATIC FIELD & TRAVELING WAVE THEORY	Lecture Hrs:12

Electrostatic field: calculation of electrostatic field of EHV/AC lines – Effect on humans, animals and plants – Electrostatic induction in un-energised circuit of double - circuit line – Electromagnetic interference - Examples. Traveling wave expression and solution - Source of excitation - Terminal conditions - Open circuited and short circuited end - Reflection and refraction coefficients - Lumped parameters of distributed lines - Generalized constants - No load voltage conditions and charging current.

UNIT - V	VOLTAGE CONTROL	Lecture Hrs:10

Power circle diagram and its use – Voltage control using synchronous condensers – Cascade connection of shunt and series compensation – Sub synchronous resonance in series capacitor – Compensated lines – Static VAR compensating system.

Textbooks:

1. Sanjay Kumar Sharma, “EHV-AC, HVDC Transmission and Distribution Engineering” 2nd Edition, 2016.
2. R. D. Begamudre, “EHVAC Transmission Engineering”, New Age International (p) Ltd.2nd revised edition, 2012.
3. M. G. Dwek, EHV Transmission, Elsevier Sc., 3rd edition, 1992.

Reference Books:

1. R. Padiyar, HVDC Transmission Systems, Wiley Eastern Ltd., New Delhi, 2nd revised edition, 1992.
2. J. Arrilaga, High Voltage Direct Current Transmission, peter pereginver Ltd. London, U.K., 2nd edition, 1998.
3. E.W. Kimbark, Direct Current Transmission-vol.1, Wiley Inter science, New York , 1st edition, 1971

Online Learning Resources:

- https://www.ae.pwr.wroc.pl/filez/20110606092353_HEV.pdf
- https://www.afdc.energy.gov/pdfs/52723.pdf 5.https://www.leb.eei.uni
- langen.de/winterakademie/2010/report/content/course03/pdf/0308.pdf

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M.TECH. IN ELECTRICAL POWER SYSTEMS / POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	RENEWABLE ENERGY SYSTEMS LAB	L	T	P	C
21D49205		0	0	4	2
	Semester	II			

Course Objectives: To make the student

- Understand how to write the coding in MATLAB/Mipower
- Apply the SVC,STATCOM for voltage profile improvements & UPFC in power system networks.
- Analyze the data related to load flows incorporating SVC & STATCOM.
- Analyze operation of TCSC, STATCOM & SSSC for a transmission line fed by an ac supply.

Course Outcomes (CO): Student will be able to

- To observe the I-V and P-V curves and Series and Parallel connection of Solar systems
- To study the sun tracking and MPPT Charge Controllers of Solar systems
- To analyze Power, Voltage & Frequency Measurement of Wind Generator
- To Understand the Effect of temperature variation and Irradiation on Photovoltaic Array

List of Experiments:

1. Draw the I-V and P-V curves of Solar Panel using PV Panel
2. Study of Series and Parallel connection of Solar Panels
3. Study of Sun tracking system
4. Maximum Power Point Tracking Charge Controllers
5. Inverter control for Solar PV based systems
6. Power, Voltage & Frequency Measurement of output of Wind Generator
7. Impact of load and wind speed on power output and its quality
8. Performance of frequency drop characteristics of induction generator at different loading condition
9. Charging and Discharging characteristics of Battery

Simulation Experiments

1. Modelling of PV Cell
2. Effect of temperature variation on Photovoltaic Array
3. Effect of Irradiation on a Photovoltaic Array
4. Design of solar PV boost converter using P&O MPPT technique

Web Sources: https://www.vlab.co.in
Note : Conduct any 7 experiments from 1-9 list and minimum 3 experiments from 1-4 of Simulation experiments

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M.TECH. IN ELECTRICAL POWER SYSTEMS/POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	FACTS DEVICES & SIMULATION LAB	L	T	P	C
21D49206		0	0	4	2
	Semester	II			

Course Objectives: To make the student

- Understand how to write the coding in MATLAB/Mipower
- Apply the SVC,STATCOM for voltage profile improvements & UPFC in power system networks.
- Analyze the data related to load flows incorporating SVC & STATCOM.
- Analyze operation of TCSC, STATCOM & SSSC for a transmission line fed by an ac supply.

Course Outcomes (CO): Student will be able to

- Understand Load balancing using compensators.
- Apply load balancing using Compenasators.
- Analyse load flow incorporating SVC & STATCOM.
- Develop a Simulation model for STATCOM & UPFC.

List of Experiments:

1. Voltage regulation using shunt and series compensation
2. Load balancing in power system network using compensators
3. Simulation of TCSC
4. Voltage profile improvement using SVC
5. Voltage profile improvement using STATCOM
6. Transient Stability enhancement using STATCOM.
7. Simulation of UPFC with mathematical models
8. Load flow incorporating SVC
9. Load flow incorporating STATCOM
10. Simulation of DVR
11. Transmission Line Characteristics (P vs δ, Q vs δ, P vs Distance, Q vs Distance and V vs Distance) with and without Compensation
12. Sizing- simulation and operation of TCR and FC-TCR for a transmission line fed by an ac supply and feeding
    (a) Resistive/inductive/capacitive load one at a time
    (b) A load which can have leading as well as lagging behaviour
13. Sizing- simulation and operation of TCSC for a transmission line fed by an ac supply and feeding
    (a) Resistive/inductive/capacitive load one at a time
    (b) A load which can have leading as well as lagging behaviour
14. Sizing- simulation and operation of STATCOM for a transmission line fed by an ac supply and feeding
    (a) Resistive/inductive/capacitive load one at a time
    (b) A load which can have leading as well as lagging behaviour
15. Sizing- simulation and operation of SSSC for a transmission line fed by an ac supply and feeding
    (a) Resistive/inductive/capacitive load one at a time
    (b) A load which can have leading as well as lagging behaviour

Web Sources: https://www.vlab.co.in

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M.TECH. IN ELECTRICAL POWER SYSTEMS / POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	RESTRUCTURED POWER SYSTEMS (PE-V)	L	T	P	C
21D49301a		3	0	0	3
	Semester	III			

Course Objectives: To make the student

- Understand basic concepts of the restructuring of power industry and market models.
- Analyze about the fundamental concepts of congestion management, Transfer Capability issues and ancillary service management.
- Apply the transmission cost allocation methods to evaluate the cost.
- Develop the operational planning activities in different competitive environment.

Course Outcomes (CO): Student will be able to

- Understand the differences between the conventional power system operation and therestructured one and basics concepts of market power, electricity pricing and competitive environment.
- Analyze the concepts of Independent System Operator (ISO) and Open Access Same-Time Information System (OASIS).
- Apply the methods to find Available Transfer Capability (ATC) and to allocate the Transmission cost.
- Develop power markets and market architectural aspects and short time Price forecasting.

UNIT – I	KEY ISSUES IN ELECTRIC UTILITIES	Lecture Hrs: 9

Introduction – Restructuring models – Independent System Operator (ISO) – Power Exchange – Market operations – Market Power – Standard cost – Transmission Pricing – Congestion Pricing – Management of Inter zonal/Intra zonal Congestion.

UNIT - II	POWER SYSTEM OPERATION IN COMPETITIVE ENVIRONMENT	Lecture Hrs: 8

Introduction – Operational Planning Activities of ISO – The ISO in Pool Markets – The ISO in Bilateral Markets – Operational Planning Activities of a GENCO.

UNIT - III	AVAILABLE TRANSFER CAPABILITY (ATC) &ELECTRICITY PRICING	Lecture Hrs: 10

Transfer Capability Issues – ATC – TTC – TRM – CBM Calculations – Calculation of ATC based on power flow – Electricity Pricing: Introduction – Electricity Price Volatility Electricity Price Indexes – Challenges to Electricity Pricing – Construction of Forward Price Curves – Short-time Price Forecasting.

UNIT - IV	OPEN ACCESS SAME-TIME INFORMATION SYSTEM (OASIS) &MARKETPOWER	Lecture Hrs: 9

Structure of OASIS – Posting of Information – Transfer capability on OASIS – Market Power: Introduction – Different types of market Power – Mitigation of Market Power – Examples

UNIT - V	TRANSMISSION COST ALLOCATION METHODS &ANCILLARY SERVICES MANAGEMENT	Lecture Hrs: 10

Transmission Cost Allocation Methods: Postage Stamp Rate Method – Contract Path Method – MW-Mile Method – Unused Transmission Capacity Method – MVA-Mile method– Comparison of cost allocation methods – Ancillary Services Management: Introduction – Reactive Power as an Ancillary Service, a Review – Synchronous Generators as Ancillary Service Providers.

Textbooks:

1. Kankar Bhattacharya, Math H.J. Boller and JaapE.Daalder, Operation of Restructured Power System, Kulwer Academic Publishers ,1st Edition ,2001
2. Mohammad Shahidehpour and Muwaffaq Alomoush, Restructured Electrical PowerSystems, Marcel

Dekker, Inc., 1st Edition ,2001.
Reference Books:
1. Loi Lei Lai, Power System Restructuring and Deregulation, John Wiley & Sons Ltd.,England, 2001.
Online Learning Resources:
1. https://nptel.ac.in/courses/108/101/108101005/

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ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN ELECTRICAL POWER SYSTEMS / POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	RELIABILITY ENGINEERING AND APPLICATION TO POWERSYSTEMS	L	T	P	C
21D49301b		3	0	0	3
	Semester	III			

Course Objectives: To make the student

- Understand the basic concepts of reliability, Probability Density and Distribution Functions.
- Analyze reliability of various systems and the Concept of Stochastic Transitional Probability Matrix.
- To apply the techniques of frequency and duration for reliability evaluation of repairable systems.
- Develop the Merged State Model for evaluating basic reliability indices and weather effects.

Course Outcomes (CO): Student will be able to

- Understand the concept of probability theory, distribution, network modeling and reliability analysis.
- Analyze the reliability functions with their relationships and Markov-modelling.
- Evaluate reliability models using frequency and duration techniques and generate various reliability models.
- Design the reliability composite systems and distribution systems for finding reliability indices.

UNIT – I	**BASICS OF PROBABILITY THEORY, DISTRIBUTION & NETWORKMODELLING**	Lecture Hrs: 8

Basic Probability Theory – Rules for Combining Probabilities of Events – Bernoulli's Trials –Probability Density and Distribution Functions – Binomial Distribution – Expected Value and Standard Deviation of Binomial Distribution – Analysis of Series, Parallel, Series-Parallel Networks – Complex Networks – Decomposition Method.

UNIT - II	**RELIABILITY FUNCTIONS**	Lecture Hrs: 12

Reliability Functions F(T), F(T), R(T), H(T) and Their Relationships – Exponential Distribution – Expected Value and Standard Deviation of Exponential Distribution – Bath Tub Curve – Reliability Analysis of Series Parallel Networks Using Exponential Distribution – Reliability Measures MTTF, MTTR, MTBF.

UNIT - III	**MARKOV MODELLING AND FREQUENCY & DURATION TECHNIQUES**	Lecture Hrs: 10

Markov Chains – Concept of Stochastic Transitional Probability Matrix– Evaluation of Limiting State Probabilities – Markov Processes One Component Repairable System – Time Dependent Probability Evaluation Using Laplace Transform Approach – Evaluation of Limiting State Probabilities Using Stpm – Two Component Repairable Models – Frequency and Duration Concept – Evaluation of Frequency of Encountering State – Mean Cycle time, for One, Two Component Repairable Models – Evaluation of Cumulative Probability and Cumulative Frequency of Encountering of Merged States – Approximate System Reliability analysis – Series parallel configuration – Basic probability indices – Cutest approach.

UNIT - IV	**APPLICATIONS TO POWER SYSTEMS -I**	Lecture Hrs: 14

Generation System Reliability Analysis: Reliability Model of a Generation System– Recursive Relation for Unit Addition and Removal – Load Modeling - Merging of Generation Load Model – Evaluation of Transition Rates for Merged State Model – Cumulative Probability, CumulativeFrequency of Failure Evaluation – LOLP, LOLE, LOEE.

UNIT - V	**APPLICATIONS TO POWER SYSTEMS - II**	Lecture Hrs: 10

Basic Techniques - Radial Networks – Evaluation of Basic Reliability Indices, PerformanceIndices – Load Point and System Reliability Indices – Customer Oriented, Loss and Energy Oriented Indices -Examples single feeder - parallel configuration RDS – Network reductiontechnique – cut set approaches – weather effects – repairable and non – repairable effects modeling and evaluation of basic probability indices.

Textbooks:

1. Reliability Evaluation of Engg. System – R. Billinton, R.N.Allan, Plenum Press, New York, reprinted in India by B.S.Publications, 2007. 2. Reliability Evaluation of Power systems – R. Billinton, R.N.Allan, Pitman Advance Publishing Program, New York, reprinted in India by B.S.Publications, 2007.
Reference Books:
1. System Reliability Concepts by Dr.V.Sankar, Himalaya Publishing House Pvt.Ltd,,Mumbai, 2015.
Online Learning Resources:
1. https://nptel.ac.in/courses/105/108/105108128/

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M.TECH. IN ELECTRICAL POWER SYSTEMS / POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	POWER SYSTEM AUTOMATION	L	T	P	C
21D49301c	(PE-V)	3	0	0	3
	Semester	III			

Course Objectives: To make the student
- Understand the basic concepts of deregulation, power system automation.
- Analyze about the energy control centers and applications of automation.
- To apply the techniques to solve the problems in deregulated system and automation.
- Develop the models to control the system and energy control centers.

Course Outcomes (CO): Student will be able to
- Understand the concepts of evolution of automation systems, SACADA, Congestion management.
- Analyze the techniques to resolve problems in energy control centers, data ware housing.
- Apply the techniques to get the optimum control in the system by using automation at the substation level and distribution level.
- Develop the real time case studies to solve the critical problems in power system automation.

UNIT – I | POWER SYSTEM CONTROL AND DEREGULATION | Lecture Hrs: 10

Introduction – Operation of power systems and modes – Organization and operator activities, Investment factor and control centre experiences – Deregulation – need for deregulation and Advantages of deregulation in power system – Restructuring Models PoolCo. Model – Bilateral Model and Hybrid Model – Independent system operator (ISO) – Role of ISO – Congestion Management.

UNIT - II | POWER SYSTEM AUTOMATION | Lecture Hrs: 9

Evolution of automation systems – SCADA in Power system – Building blocks of SCADA system – Remote terminal unit – Intelligent electronic devices – Data concentrators and merging units – SCADA communication systems – Master station – Human-machine interface – Classification of SCADA systems.

UNIT - III | SUBSTATION AUTOMATION | Lecture Hrs: 10

Substation automation – Conventional automation – New smart devices for substation automation – new integrated digital substation – Technical issues new digital simulation – Substation automation architectures – Substation automation applications functions – Benefits of data warehousing.

UNIT - IV | ENERGY CONTROL CENTERS | Lecture Hrs: 10

Introduction – Energy control centers – EMS framework – Data acquisition and communication – Generation operation and management – Transmission operations – Real time Study-mode Simulations – Post-event analysis and energy scheduling and accounting – Dispatcher training simulator – Smart transmission.

UNIT - V | DISTRIBUTION AUTOMATION | Lecture Hrs: 10

Introduction to Distribution automation – Customer, feeder and substation automation – Subsystems in a distribution control center – Distributed Management System (DMS) framework integration with subsystems – Advanced real-time DMS applications – Advanced analytical DMS applications – DMS coordination with other systems.

Textbooks:

1. M Shahidehpour, Muwaffaq Alomoush, Restructured electrical power systems operation, trading and volatility, CRC Press, 1st Edition, 2001.
2. Mini S Thomas and John D Mcdonald, Power System SCADA and Smart Grids, CRC Press, 1st Edition 2015.

Reference Books:

1. Torsten cegrell, Power systems control Technology, Prentice Hall, 1st Edition, 1986.
2. James Northcote-Green and Robert Wilson, Control and Automation of Electrical Power Distribution Systems, CRC Press, 1st Edition, 2013.
3. Edmund Handschin, Real time control of Electric Power System, Elsevier Publishing Company, 1st Edition, 1972.

Online Learning Resources:

1. https://nptel.ac.in/courses/108/106/108106022/

AUDIT COURSE-I

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M.TECH. IN ELECTRICAL POWER SYSTEMS/POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	**ENGLISH FOR RESEARCH PAPER WRITING**	**L**	**T**	**P**	**C**
21DAC101a		**2**	**0**	**0**	**0**
	Semester	**I**			

Course Objectives: This course will enable students:

- Understand the essentials of writing skills and their level of readability
- Learn about what to write in each section
- Ensure qualitative presentation with linguistic accuracy

Course Outcomes (CO): Student will be able to

- Understand the significance of writing skills and the level of readability
- Analyze and write title, abstract, different sections in research paper
- Develop the skills needed while writing a research paper

UNIT - I	Lecture Hrs:10

1Overview of a Research Paper- Planning and Preparation- Word Order- Useful Phrases - Breaking up Long Sentences-Structuring Paragraphs and Sentences-Being Concise and Removing Redundancy -Avoiding Ambiguity

UNIT - II	Lecture Hrs:10

Essential Components of a Research Paper- Abstracts- Building Hypothesis-Research Problem - Highlight Findings- Hedging and Criticizing, Paraphrasing and Plagiarism, Cauterization

UNIT - III	Lecture Hrs:10

Introducing Review of the Literature – Methodology - Analysis of the Data-Findings - Discussion-Conclusions-Recommendations.

UNIT - IV	Lecture Hrs:9

Key skills needed for writing a Title, Abstract, and Introduction

UNIT - V	Lecture Hrs:9

Appropriate language to formulate Methodology, incorporate Results, put forth Arguments and draw Conclusions

Suggested Reading

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) Model Curriculum of Engineering & Technology PG Courses [Volume-I]
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman’sbook
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

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M.TECH. IN ELECTRICAL POWER SYSTEMS / POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	DISASTER MANAGEMENT	L	T	P	C
21DAC101b		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- Learn to demonstrate critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from Multiple perspectives.
- Developanunderstandingofstandardsofhumanitarianresponseandpracticalrelevanceinspecific types of disasters and conflict situations
- Criticallyunderstandthestrengthsandweaknessesofdisastermanagementapproaches,planningand programming in different countries, particularly their home country or the countries they work in

UNIT - I

Introduction:
Disaster:Definition,FactorsandSignificance;DifferenceBetweenHazardandDisaster;Naturaland Manmade Disasters: Difference, Nature, Types and Magnitude.

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:
Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes,Volcanisms,Cyclones,Tsunamis,Floods,DroughtsandFamines,Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT - III

Disaster Preparedness and Management:
Preparedness: Monitoring of Phenomena Triggering ADisasteror Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT - IV

Risk Assessment Disaster Risk:
Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. TechniquesofRiskAssessment,GlobalCo-OperationinRiskAssessmentand Warning, People’s Participation in Risk Assessment. Strategies for Survival.

UNIT - V

Disaster Mitigation:
Meaning,ConceptandStrategiesofDisasterMitigation,EmergingTrendsInMitigation.Structural Mitigationand Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Suggested Reading

1. R.Nishith,SinghAK,“DisasterManagementinIndia:Perspectives,issuesandstrategies
2. “’New Royal book Company..Sahni,PardeepEt.Al.(Eds.),”DisasterMitigationExperiencesAndReflections”,PrenticeHall OfIndia, New Delhi.
3. GoelS.L.,DisasterAdministrationAndManagementTextAndCaseStudies”,Deep&Deep Publication Pvt. Ltd., New Delhi

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M.TECH. IN ELECTRICAL POWER SYSTEMS / POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	SANSKRITFOR TECHNICAL KNOWLEDGE	L	T	P	C
21DAC101c		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- LearningofSanskrittodevelopthelogicinmathematics,science&othersubjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge
- Knowledge from ancientliterature

Course Outcomes (CO): Student will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science &technology can be understood
- Being a logical language will help to develop logic in students

UNIT - I

Alphabets in Sanskrit,

UNIT - II

Past/Present/Future Tense, Simple Sentences

UNIT - III

Order, Introduction of roots

UNIT - IV

Technical information about Sanskrit Literature

UNIT - V

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested Reading

1.“Abhyaspustakam” –Dr.Vishwas, Sanskrit-Bharti Publication, New Delhi
2.“Teach Yourself Sanskrit” Prathama Deeksha- VempatiKutumbshastri, RashtriyaSanskrit Sansthanam, New Delhi Publication
3.“India’s Glorious ScientificTradition” Suresh Soni, Ocean books (P) Ltd.,New Delhi

AUDIT COURSE-II

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M.TECH. IN ELECTRICAL POWER SYSTEMS / POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	PEDAGOGY STUDIES	L	T	P	C
21DAC201a		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

- Reviewexistingevidenceonthereviewtopictoinformprogrammedesignandpolicy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes (CO): Student will be able to

Students will be able to understand:

- Whatpedagogicalpracticesarebeingusedbyteachersinformalandinformalclassrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- Howcanteachereducation(curriculumandpracticum)andtheschoolcurriculumand guidance materials best support effective pedagogy?

UNIT - I

Introduction and Methodology: Aims and rationale, Policy back ground, Conceptual frame work and terminology Theories oflearning,Curriculum,Teachereducation.Conceptualframework,Research questions**.** Overview of methodology and Searching.

UNIT - II

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT - III

Evidence on theeffectivenessofpedagogicalpractices,Methodologyfortheindepthstage:quality assessmen t of included studies. How can teacher education (curriculumandpracticum) andthescho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of th body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT - IV

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacherandthecommunity.Curriculumandassessment,Barrierstolearning:limitedresourcesand large class sizes

UNIT - V

Researchgapsandfuturedirections: Researchdesign**,**Contexts**,**Pedagogy**,**Teachereducation**,** Curriculum and assessment**,** Dissemination and research impact.

Suggested Reading

1. AckersJ,HardmanF(2001)ClassroominteractioninKenyanprimaryschools,Compare, 31 (2): 245-261.
2. AgrawalM(2004)Curricularreforminschools:Theimportanceofevaluation,Journalof

3. Curriculum Studies, 36 (3): 361-379.
4. AkyeampongK(2003) Teacher training in Ghana - does it count? Multi-site teachereducation research project (MUSTER) country report 1. London: DFID.
5. Akyeampong K, LussierK, PryorJ, Westbrook J (2013)Improving teaching and learning of basic maths and reading in Africa: Does teacherpreparation count?International Journal Educational Development, 33 (3): 272–282.
6. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
   Chavan M (2003)ReadIndia: A mass scale, rapid, ‘learning to read’campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

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M.TECH. IN ELECTRICAL POWER SYSTEMS / POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	STRESSMANAGEMENT BY YOGA	L	T	P	C
21DAC201b		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

- To achieve overall health of body and mind
- To overcome stres

Course Outcomes (CO): Student will be able to

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT - I

Definitions of Eight parts of yog.(Ashtanga)

UNIT - II

Yam and Niyam.

UNIT - III

Do`sand Don't'sin life.

i) Ahinsa,satya,astheya,bramhacharyaand aparigrahaii) Shaucha,santosh,tapa,swadhyay,ishwarpranidhan

UNIT - IV

Asan and Pranayam

UNIT - V

i)Variousyogposesand theirbenefitsformind &body

ii)Regularizationofbreathingtechniques and its effects-Types ofpranayam

Suggested Reading

1.'Yogic Asanas forGroupTarining-Part-I": Janardan SwamiYogabhyasiMandal, Nagpur
2."Rajayogaor conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

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M.TECH. IN ELECTRICAL POWER SYSTEMS/POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	PERSONALITY DEVELOPMENT THROUGHLIFE ENLIGHTENMENTSKILLS	L	T	P	C
21DAC201c		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

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

Course Outcomes (CO): Student will be able to

- StudyofShrimad-Bhagwad-Geetawillhelpthestudentindevelopinghispersonalityand achieve the highest goal in life
- The person who has studied Geetawilllead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT - I

Neetisatakam- Holistic development of personality
Verses-19,20,21,22(wisdom)
Verses-29,31,32(pride &heroism)
Verses-26,28,63,65(virtue)

UNIT - II

Neetisatakam- Holistic development of personality
Verses-52,53,59(dont's)
Verses-71,73,75,78(do's)

UNIT - III

Approach to day to day work and duties.
ShrimadBhagwadGeeta:Chapter2-Verses41,47,48,
Chapter3-Verses13,21,27,35,Chapter6-Verses5,13,17,23,35,
Chapter18-Verses45,46,48.

UNIT - IV

Statements of basic knowledge.
ShrimadBhagwadGeeta:Chapter2-Verses 56,62,68
Chapter12 -Verses13,14,15,16,17,18
Personality of Rolemodel. Shrimad Bhagwad Geeta:

UNIT - V

Chapter2-Verses 17,Chapter3-Verses36,37,42,
Chapter4-Verses18,38,39
Chapter18– Verses37,38,63

Suggested Reading

1.“SrimadBhagavadGita”bySwamiSwarupanandaAdvaitaAshram(PublicationDepartment), Kolkata
2.Bhartrihari’sThree Satakam (Niti-sringar-vairagya) by P.Gopinath, RashtriyaSanskrit Sansthanam, New Delhi.

OPEN ELECTIVE

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M.TECH. IN ELECTRICAL POWER SYSTEMS/POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	WASTE TO ENERGY	L	T	P	C
21DOE301e		3	0	0	3
	Semester	III			

Course Objectives:

- Introduce and explain energy from waste, classification and devices to convert waste to energy.
- To impart knowledge on biomass pyrolysis, gasification, combustion and conversion process.
- To educate on biogas properties ,bio energy system, biomass resources and their classification and biomass energy programme in India.

Course Outcomes (CO): Student will be able to

- To know about overview of Energy to waste and classification of waste.
- To acquire knowledge on bio mass pyrolysis, gasification, combustion and conversion process in detail.
- To gain knowledge on properties of biogas, biomass resources and programmes to convert waste to energy in India.

UNIT - I — Lecture Hrs:10

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT - II — Lecture Hrs:10

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT - III — Lecture Hrs:12

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation

UNIT - IV — Lecture Hrs:12

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

UNIT - V — Lecture Hrs:10

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification -

Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification- pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Textbooks:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 2018
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., TMH, 2017

Reference Books:

1. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996

Online Learning Resources:
https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-ch13/ https://www.youtube.com/watch?v=x2KmjbCvKTk

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M.TECH. IN ELECTRICAL POWER SYSTEMS/POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	**COST MANAGEMENT OF ENGINEERING PROJECTS**	**L**	**T**	**P**	**C**
21DOE301a		**3**	**0**	**0**	**3**
	Semester	**III**			

Course Objectives:

- To explain cost concepts and objectives of costing system and cost management process
- To provide knowledge and explain Cost behaviour in relation to Volume and Profit and pricing decisions.
- To know the concepts of target costing, life cycle costing and activity based cost management in a project or business.
- To discuss on budget and budgetary control , type of budgets in a business to control costs
- To provide knowledge on project, types of projects, stages of project execution, types of project contracts and project cost control.

Course Outcomes (CO): Student will be able to

- Know the cost management process and types of costs
- Learn and apply different costing methods under different project contracts
- To understand relationship of Cost-Volume and Profit and pricing decisions.
- Prepare budgets and measurement of divisional performance.
- Acquires knowledge on various types of project contracts, stages to execute projects and controlling project cost..

UNIT - I — Lecture Hrs:10

Introduction and Overview of the Strategic Cost Management Process - Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT - II — Lecture Hrs:12

Cost Behavior and Profit Planning: Marginal Costing- Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems; Pareto Analysis Just-in-time approach, Theory of constraints.; Divisional performance management: - Measurement of Divisional profitability - pricing decisions - transfer pricing.

UNIT - III — Lecture Hrs:10

Target costing- Life Cycle Costing - Activity-Based Cost management:- Activity based costing- Value-Chain Analysis- Bench Marking; Balanced Score Card.

UNIT - IV — Lecture Hrs:10

Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT - V — Lecture Hrs:12

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

Textbooks:

1. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting

2. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
Reference Books:
1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi 2. Charles T. Horngren and George Foster, Advanced Management Accounting 3. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd
Online Learning Resources:
https://nptel.ac.in/courses/105/104/105104161/ https://nptel.ac.in/courses/112/102/112102106/

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M.TECH. IN ELECTRICAL POWER SYSTEMS/POWER SYSTEMS

COMMON COURSE STRUCTURE & SYLLABI

Course Code	**INTERNET OF THINGS& ITS APPLICATIONS**	**L**	**T**	**P**	**C**
21DOE301i		**3**	**0**	**0**	**3**
	Semester	**III**			

Course Objectives:

- Introduce the fundamental concepts of IoT and physical computing
- Expose the student to a variety of embedded boards and IoT Platforms
- Create a basic understanding of the communication protocols in IoT communications.
- Familiarize the student with application program interfaces for IoT.
- Enable students to create simple IoT applications.

Course Outcomes (CO): Student will be able to

- Choose the sensors and actuators for an IoT application
- Select protocols for a specific IoT application
- Utilize the cloud platform and APIs for IoT applications
- Experiment with embedded boards for creating IoT prototypes
- Design a solution for a given IoT application
- Establish a startup

UNIT - I | Lecture Hrs:

Overview of IoT:
The Internet of Things: An Overview, The Flavor of the Internet of Things, The "Internet" of "Things", The Technology of the Internet of Things, Enchanted Objects, Who is Making the Internet of Things?
Design Principles for Connected Devices: Calm and Ambient Technology, Privacy, Web Thinking for Connected Devices, Affordances.
Prototyping: Sketching, Familiarity, Costs Vs Ease of Prototyping, Prototypes and Production, Open source Vs Close source, Tapping into the community.

UNIT - II | Lecture Hrs:

Embedded Devices:
Electronics, Embedded Computing Basics, Arduino, Raspberry Pi, Mobile phones and tablets, Plug Computing: Always-on Internet of Things

UNIT - III | Lecture Hrs:

Communication in the IoT:
Internet Communications: An Overview, IP Addresses, MAC Addresses, TCP and UDP Ports, Application Layer Protocols
Prototyping Online Components:
Getting Started with an API, Writing a New API, Real-Time Reactions, Other Protocols Protocol

UNIT - IV | Lecture Hrs:

Business Models: A short history of business models, The business model canvas, Who is the business model for, Models, Funding an Internet of Things startup, Lean Startups.
Manufacturing: What are you producing, Designing kits, Designing printed circuit boards.

UNIT - V | Lecture Hrs:

Manufacturing continued: Manufacturing printed circuit boards, Mass-producing the case and other fixtures, Certification, Costs, Scaling up software.
Ethics: Characterizing the Internet of Things, Privacy, Control, Environment, Solutions

Textbooks:

1.Adrian McEwen, Hakim Cassimally - Designing the Internet of Things, Wiley Publications, 2012

Reference Books:

1. HaiderRaad Fundamentals of IoT and Wearable Technology Design, Wiley Publications2020.
2. KashishAraShakil,Samiya Khan, Internet of Things (IoT) Concepts and Applications,Springer Publications 2020.

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M.TECH. IN CAD/CAM
COURSE STRUCTURE & SYLLABI

SEMESTER – I

	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21DBS101	Computational Methods	PC	3	0	0	3
2.	21D04101	Advanced Finite Element Methods	PC	3	0	0	3
3.	21D04102a 21D04102b 21D04102c	**Program Elective Course - I** Computer Integrated Manufacturing Design for Cellular Manufacturing System Design of Hydraulic & Pneumatic System	PE	3	0	0	3
4.	21D04103a 21D04103b 21D04103c	**Program Elective Course – II** Advances in Manufacturing Technology Quality Engineering and Manufacturing Computer Aided Process Planning	PE	3	0	0	3
5.	21D04104	Geometric Modeling Laboratory	PC	0	0	4	2
6.	21D04105	Finite Element Analysis Laboratory	PC	0	0	4	2
7.	21DRM101	Research Methodology and IPR	MC	2	0	0	2
8.	21DAC101a 21DAC101b 21DAC101c	**Audit Course – I** English for Research paper writing Disaster Management Sanskrit for Technical Knowledge	AC	2	0	0	0
		Total					**18**

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SEMESTER – II

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D04201	Advanced Optimization Techniques	PC	3	0	0	3
2.	21D04202	Industrial Robotics and Expert Systems	PC	3	0	0	3
3.	 21D04203a 21D04203b 21D04203c	**Program Elective Course – III** CNC Technology & Programming Computer Graphics Global Integrated Manufacturing	PE	3	0	0	3
4.	 21D04204a 21D04204b 21D04204c	**Program Elective Course – IV** Mechatronics Applications in Manufacturing Rapid Prototyping Artificial Intelligence & Expert Systems	PE	3	0	0	3
5.	21D04205	Process Automation Laboratory	PC	0	0	4	2
6.	21D04206	CAM Laboratory	PC	0	0	4	2
7.	21D04207	Technical seminar	PR	0	0	4	2
8.	 21DAC201a 21DAC201b 21DAC201c	**Audit Course – II** Pedagogy Studies Stress Management for Yoga Personality Development through Life Enlightenment Skills	AC	2	0	0	0
		Total					**18**

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SEMESTER - III

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	 21D04301a 21D04301b 21D04301c	**Program Elective Course – V** Advanced Tool Design Design for Manufacturing Computer Aided Tools for Manufacturing	PE	3	0	0	3
2.	 21DOE301c 21DOE301g 21DOE301h	**Open Elective** Business Analytics Internet Of Things Mechatronics	OE	3	0	0	3
3.	21D04302	Dissertation Phase – I	PR	0	0	20	10
4.	21D04303	Co-curricular Activities					2
Total							18

SEMESTER - IV

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D04401	Dissertation Phase – II	PR	0	0	32	16
Total							**16**

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Course Code	**COMPUTATIONAL METHODS**	**L**	**T**	**P**	**C**
21DBS101		**3**	**0**	**0**	**3**
	Semester	**I**			

Course Objectives: Student will be able to

- Demonstrate aptitude in standard numerical techniques for solvingvarious classes of problems.
- Learn the theory underlying the derivation of standard numerical techniques and the development of algorithms.
- Modeling of engineering problems drawn from different disciplines of mechanicalengineering.

Course Outcomes (CO): Student will be able

- To enable students to formulate and solve engineering problems that are not amenable to analytical methods.
- To demonstrate the application of numerical methods to data analysis and optimal design.

UNIT – I		Lecture Hrs:09

Introduction to numerical methods applied to engineering problems: Examples, solving sets of equations – Matrix notation – Determinants and inversion – Iterative methods – Relaxation methods – System of non-linear equations – computer programs

Numerical integration: Newton-Cotes integration formulas – Simpson's rules, Gaussian quadrature. Adaptive integration

UNIT – II		Lecture Hrs: 09

Optimization: One dimensional unconstrained optimization, multidimensional unconstrained optimization –direct methods and gradient search methods, constrainedoptimization
Boundary value problems and characteristic value problems: Shooting method – Solution through a set of equations – Derivative boundary conditions – Rayleigh – Ritz method – Characteristic value problems.

UNIT – III		Lecture Hrs: 09

Numerical solutions of partial differential equations: Laplace's equations – Representations as a difference equation – Iterative methods for Laplace's equations – poisson equation – Examples – Derivative boundary conditions – Irregular and non – rectangular grids – Matrix patterns, sparseness – ADI method – Finite element method.

UNIT – IV		Lecture Hrs: 09

Parabolic partial differential equations: Explicit method – Crank-Nickelson method – Derivative boundary condition – Stability and convergence criteria – Finite element for heat flow – computer programs.

Hyperbolic partial differential equations: Solving wave equation by finite differences- stability of numerical method –method of characteristics-wave equation in two space dimensions-computer programs.

UNIT - V		Lecture Hrs: 09

Curve fitting and approximation of functions: Least square approximation fitting of non-linear curves by least squares –regression analysis- multiple linear regression, non linear regression - computer programs.

Textbooks:

1. "Numerical Methods for Engineers", Steven C.Chapra, Raymond P.Canale Tata Mc-Graw hill
2. "Applied numerical analysis", Curtis F.Gerald, partick.O.WheatlyAddison-wesley,1989
3. "Numerical methods", Douglas J..Faires,Riched BurdenBrooks/cole publishing company,1998.Second edition.

Reference Books:

1. "Numerical mathematics and computing", Ward cheney &David Kincaid Brooks/Cole publishing company1999,fourth edition.
2. "Mathematical methods for physics and engineering"Riley K.F.M.P.Hobson.&.Bence S.J.Cambridge university press,1999.

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Course Code	ADVANCED FINITE ELEMENT METHODS	L	T	P	C
21D04101		3	0	0	3
	Semester	I			

Course Objectives:

- You learn modern analysis techniques used widely in engineering practice and the sciences, and you use these techniques in a general finite element program.
- You learn how to establish computational models of problems of solids and fluids, solve them on your laptop, and assess the accuracy of the results.
- You capitalize on your knowledge of mechanics, reinforce your knowledge, and solve problems that can only be tackled numerically on the computer. Great knowledge in your tool box whatever your goals.

Course Outcomes (CO): Student will be able to

- Students will learn the mathematical formulation of the finite element method and how to apply it to basic (linear) ordinary and partial differential equations.
- Solve 1- D problems. & 2- D Structural & Heat Transfer Problems using FEA
- Solve Trusses & Beams Problems using FEA
- Formulate & solve structural & dynamics problems

UNIT - I		Lecture Hrs: 09

Formulation Techniques: Methodology, Engineering problems and governing differential equations, finite elements., Variational methods-potential energy method, Raleigh Ritz method, strong and weak forms, Galerkin and weighted residual methods, calculus of variations, Essential and natural boundary conditions.

UNIT - II		Lecture Hrs: 09

One-dimensional finite element methods: Bar elements, temperature effects. Element matrices, assembling of global stiffness matrix, Application of boundary conditions, Elimination and penalty approaches, solution for displacements, reaction, stresses, temperature effects, Quadratic Element, Heat transfer problems: One-dimensional, conduction and convection problems. Examples: - one dimensional fin,

UNIT - III		Lecture Hrs: 09

Trusses: Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses, temperature effects.

Beams and Frames: Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses.

UNIT - IV		Lecture Hrs: 09

Two dimensional problems: CST, LST, four noded and eight nodded rectangular elements, Lagrange basis for triangles and rectangles, serendipity interpolation functions. Axisymmetric Problems: Axisymmetric formulations, Element matrices, boundary conditions. Heat Transfer problems: Conduction and convection, examples: - two-dimensional fin.

Isoparametric formulation: Concepts, sub parametric, super parametric elements, numerical integration.

UNIT - V		Lecture Hrs: 09

Finite elements in Structural Dynamics: Dynamic equations, eigen value problems, and their solution methods, simple problems.

Convergence: Requirements for convergence, h-refinement and p-refinement, complete and incomplete interpolation functions, pascal's triangle.

Textbooks:

1. Introduction to Finite element methods by Chandraputla & Ashok D.Belagondu by Pearson 2012A
2. Concepts and Applications of Finite Element Analysis By Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt

Reference Books:

1. Finite element method in Heat transfer and fluid dynamics, J.N.Reddy, CRC press,1994
2. Finite Element Method, Zienckiwicz O.C. & R. L. Taylor,McGraw-Hill,1983.
3. Finite Element of Nonlinear continua, . J. N. Oden, McGraw-Hill, New York, 1971.
4. Finite element procedures, K. J. Bathe, Prentice-Hall, 1996.

Online Learning Resources:

- https://nptel.ac.in/courses/112/104/112104193/
- https://nptel.ac.in/courses/112/104/112104205/
- https://nptel.ac.in/courses/105/105/105105041/
- https://nptel.ac.in/courses/112/106/112106130/
- https://nptel.ac.in/courses/112/103/112103295/

Course Code	**COMPUTER INTEGRATED MANUFACTURING**	**L**	**T**	**P**	**C**
21D04102a	**Program Elective Course - I**	**3**	**0**	**0**	**3**

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	Semester	**I**

Course Objectives: Student will be able

- To gain knowledge about the basic fundamental of CAD.
- To gain knowledge on how computers are integrated at various levels of planning and manufacturing understand computer aided planning and control and computer monitoring.

Course Outcomes (CO): Student will be able to

- Understand the importance of product development through CIM. Get knowledge of shop floor control , Computer Integrated Manufacturing and Automation.
- Adopt appropriate material handling and storage in an automated manufacturing environment.
- Incorporate methods of utilization of appropriate features in CAD application enhancing productivity in design

UNIT - I	**Unit – I Introduction:**	Lecture Hrs:09

Fundamental concepts in Manufacturing and Automation, Automation Strategies, Economic analysis in production, fundamentals of CAD / CAM, product cycle and CAD/CAM, Automation and CAD/CAM, Scope of CIM, Automated flow lines, Transfer mechanisms, methods of Line balancing.
Numerical control machines: Introduction- basic components of an NC system-the NC procedure- NC coordinate system, NC motion control system- application of numerical control- Economics of Numerical control.

UNIT - II	**Unit – II NC part programming:**	Lecture Hrs: 09

Introduction - The Bunch tape in NC - Tape code format - manual part programming. NC programming with manual data input.

UNIT - III	**Unit – III Computer controls in NC:**	Lecture Hrs: 09

NC controllers' technology - Computer Numerical Control (CNC), Direct Numerical control (DNC).
Group Technology: Part families, parts classification and coding, production flow analysis, Composite part concept, Machine cell design, benefits of GT

UNIT - IV	**Unit – IV Flexible Manufacturing Systems**	Lecture Hrs: 09

Components of FMS, FMS Work stations, Material Handling Systems, and Computer Control system, FMS layout configurations and benefits of FMS.
Computer aided planning systems: Approaches to Computer aided Process Planning (CAPP) - Generative and Retrieval CAPP systems, benefits of CAPP, Material Requirement Planning (MRP), mechanism of MRP, benefits, and Capacity Planning.

UNIT - V	Computer integrated manufacturing	Lecture Hrs: 09

Adaptive control machining systems. adaptive control optimization system, adaptive control constraint system, applications to machining processes, computer process monitoring, hierarchical structure of computers in manufacturing, and computer process control.

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Textbooks:
1. Automation, Production systems and Computer Integrated Manufacturing Systems – Mikel P.Groover, PHI Publishers
Reference Books:
1. CAD/CAM - Mikell P.Groover, and Emory W. Zimmers.Jr. PHI Publishers 2. Computer Aided Design and Manufacturing, K.Lalit Narayan, K.Mallikarjuna Rao, MMM Sarcar, PHI Publishers 3. CAD/CAM/CIM, Radhakrishnan and Subramanian, New Age Publishers
Online Learning Resources:
1.https://en.wikipedia.org/wiki/Computer-integrated_manufacturing 2. https://www.techopedia.com/definition/30965/computer-integrated-manufacturing-cim 3. https://www.youtube.com/watch?v=_OaBMsUgqgQ 4. https://www.youtube.com/watch?v=edplvB_Xvso 5. https://nptel.ac.in/courses/112/104/112104289/ 6. https://www.youtube.com/watch?v=9fqygvj-O2s.

Course Code	**DESIGN FOR CELLULAR MANUFACTURING SYSTEM (PE-I)**	**L**	**T**	**P**	**C**
21D04102b		**3**	**0**	**0**	**3**
	Semester	**I**			

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Course Objectives: Student will be able to		
• To impart knowledge on group technology, optimization algorithms, implementation of GT/CMS, Performance measurements and economical aspects of CMS.		
Course Outcomes (CO):		
At the end of this course the student should be able to understand • Concepts and applications of Cellular manufacturing systems • Traditional and non-traditional approaches of Problem solving • Performance measurement • Human and economical aspects of CMS.		
UNIT - I	**INTRODUCTION**	Lecture Hrs:09
Introduction to Group Technology, Limitations of traditional manufacturing systems, characteristics and design of groups, benefits of GT and issues in GT.		
UNIT - II	**CMS PLANNING AND DESIGN**	Lecture Hrs:09
Problems in GT/CMS - Design of CMS - Models, traditional approaches and non-traditional approaches - Genetic Algorithms, Simulated Annealing, Neural networks		
UNIT - III	IMPLEMENTATION OF GT/CMS	Lecture Hrs:09
Inter and Intra cell layout, cost and non-cost based models, establishing a team approach, Managerial structure and groups, batch sequencing and sizing, life cycle issues in GT/CMS		
UNIT - IV	**PERFORMANCE MEASUREMENT AND CONTROL**	Lecture Hrs:09
Measuring CMS performance - Parametric analysis - PBC in GT/CMS, cell loading, GT and MRP - framework.		
UNIT - V	**ECONOMICS OF GT/CMS**	Lecture Hrs:09
Conventional Vs group use of computer modelss in GT/CMS, Human aspects of GT/CMS - cases.		
Text Books:		
1. Askin, R.G. and Vakharia, A.J., G.T " Planning and Operation, in The automated factory-Hand Book: Technology and Management ", Cleland.D.I. and Bidananda, B (Eds), TAB Books , NY, 1991. 2. Kamrani, A.K, Parsaei, H.R and Liles, D.H. (Eds), " Planning, design and analysis of cellular manufacturing systems ", Elsevier, 1995.		
Reference Books:		

1. Burbidge, J.L. Group " Technology in Engineering Industry ", Mechanical Engineering pub.London, 1979. 2. Irani, S.A. " Cellular Manufacturing Systems ", Hand Book.
Online Learning Resources: • https://nptel.ac.in/courses/110/106/110106044/ • https://www.youtube.com/watch?v=toTYb7Sirm0 • https://www.youtube.com/watch?v=Ynhp8Wi2qwM • https://nptel.ac.in/courses/112/104/112104188/ • https://nptel.ac.in/courses/110/107/110107141/ • https://www.youtube.com/watch?v=voN_297SXD8

Course Code	DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS (PE-I)	L	T	P	C
21D04102c		3	0	0	3
	Semester	I			
Course Objectives:					
• Power in Industry. Also to impart knowledge on the methodology of basic and advanced design of pneumatics and hydraulics systems.					

- It helps students to get knowledge on the need, use and application of fluid power.

Course Outcomes (CO): Student will be able to

- Familiar to industrial design that lead to automation.
- To impartstudents on the science, use and application of hydraulics and pneumatics as fluid.

UNIT – I		Lecture Hrs:09

OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS

Hydraulic Power Generators – Selection and specification of pumps, pump characteristics. Linear and Rotary Actuators – selection, specification and characteristics.

UNIT – II		Lecture Hrs: 09

CONTROL AND REGULATION ELEMENTS

Pressure - direction and flow control valves - relief valves, non-return and safety valves - actuation systems.

UNIT – III		Lecture Hrs: 09

HYDRAULIC CIRCUITS

Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits - industrial circuits - press circuits - hydraulic milling machine - grinding, planning, copying, - forklift, earth mover circuits- design and selection of components - safety andemergency mandrels.

UNIT – IV		Lecture Hrs: 09

PNEUMATIC SYSTEMS AND CIRCUITS

Pneumatic fundamentals - control elements, position and pressure sensing - logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods - step counter method - compound circuit design - combination circuit design.

UNIT – V		Lecture Hrs: 09

INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS

Pneumatic equipments- selection of components - design calculations – application -fault finding - hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

Textbooks:

1. Andrew Parr, “Hydraulic and Pneumatics” (HB), Jaico Publishing House, 1999.
2. Bolton. W., “Pneumatic and Hydraulic Systems “, Butterworth –Heinemann, 1997.

Reference Books:
1. Antony Espossito, "Fluid Power with Applications", Prentice Hall, 1980. 2. Dudleyt, A. Pease and John J. Pippenger, "Basic fluid power", Prentice Hall, 1987. 3. K.Shanmuga Sundaram, "Hydraulic and Pneumatic Controls: Understanding made Easy" S.Chand & Co Book publishers, New Delhi, 2006 (Reprint 2009).
Online Learning Resources:
• https://nptel.ac.in/courses/112/103/112103249/ • https://nptel.ac.in/courses/112/106/112106175/ • https://nptel.ac.in/content/storage2/courses/112106175/Module%201/Lecture%201.pdf • https://www.vidyarthiplus.com/vp/attachment.php?aid=18972 • https://snscourseware.org/snscenew/notes.php?cw=CW_5e27ec3b0457a

Course Code	**ADVANCES IN MANUFACTURING TECHNOLOGY**	**L**	**T**	**P**	**C**
21D04103a	**Program Elective Course - II**	**3**	**0**	**0**	**3**
	Semester	**I**			

Course Objectives: Students able to
• Understand the "Technology Generation and Practical Deployment for enabling industries to face global competition" as opposed to "Technology Acquisition and Adoption". • Provide an integrated, effective and practical platform for • Create facilities for teaching, training and research & development work for post-graduate studies in various fields of manufacturing technology • Link up with national and international colleges/ universities of excellence to impart the education,

maintain quality & content of curriculum and award degree certificates in post-Graduation / Doctorates
- Provide facilities for international and national subject experts to stay, teach and conduct research projects / programmes on mutual exchange and recognition basis

Course Outcomes (CO): Students able to

- Analyze technical problems, propose solutions and document with written and oral reports.
- Employ technology for communications, data collection, analysis, simulation and control.
- Use Basic Project management skills, project team work and ethical behavior.
- Machine variety materials using a conversational and CNC lathe, milling machine and grinder.
- Use the basic manufacturing methods, measurements, automation and quality control.
- Code PLCs and micro controllers for networking and system control applications.
- Apply engineering design and project management principles.
- Use CAD/CAM and apply it to engineering graphics and mechanical design.
- Apply the basics of engineering materials, structures and to mechanical design.
- Read blueprints, perform component measurements and utilize the Machinery's Handbook.

UNIT - I	Surface Processing Operations	Lecture Hrs: 09

Plating and Related Processes, Conversion Coatings, Physical Vapor Deposition, Chemical Vapor Deposition, Organic Coatings, Porcelain Enameling and other Ceramic coatings, Thermal and Mechanical Coating Processes.

UNIT - II	Un-conventional Machining Methods	Lecture Hrs: 09

Abrasive jet machining **-** Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent developments. Ultrasonic machining: Elements of the process, machining parameters, effect of parameters on surface finish and metal removal rate, mechanics of metal removal process parameters, economic considerations, applications and limitations.

UNIT - III	Electro-Chemical Processes	Lecture Hrs: 09

Electro-Chemical Processes: Fundamentals of electro chemical machining, metal removal rate in ECM, Tool design, Surface finish and accuracy economics aspects of ECM.
Wire EDM Process: General Principle and applications of Wire EDM, Mechanics of metal removal, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy.

UNIT - IV	Electron Beam Machining	Lecture Hrs: 09

Generation and control of electron beam for machining, theory of electron beam machining, principle, advantages, limitations, comparison of thermal and non-thermal processes.
Plasma Arc Machining: Principle, machining parameters, effect of machining parameters on surface finish and metal removal rate, applications, limitations

UNIT - V	Laser Beam Machining	Lecture Hrs: 09

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Principle, effect of machining parameters on surface finish, applications, and limitations. **Rapid Prototyping:** Working principle, methods-Steriolithography, Laser sintering, Fused deposition method, applications and limitations.
Text Books:
1. Manufacturing Technology - P. N. Rao, TMH Publishers 2. Fundamentals of Modern Manufacturing, Mikell P. Groover, John Wiley & Sons Publishers
Reference Books:
1.Production Technology - HMT 2.Manufacturing Science - Cambel 3.Welding Technology - R.S, Parmar, 4. Introduction to Nanotechnology - Poole and Owens, Wiley (2003). Outcomes
Online Learning Resources:
• https://nptel.ac.in/courses/112/107/112107078/ • https://youtu.be/t3y_Ys3LgGM • https://www.youtube.com/watch?v=E4VZ_rFqpG4&t=1s • https://youtu.be/-tcaR7oSx_w • https://youtu.be/Uybg6VDLoRQ • https://youtu.be/Uybg6VDLoRQ • https://youtu.be/aWQsEX1TrSI

Course Code	**QUALITY ENGINEERING AND MANUFACTURING**	**L**	**T**	**P**	**C**
21D04103b	**Program Elective Course - II**	**3**	**0**	**0**	**3**
	Semester	**I**			
Course Objectives: Student will be able to					
• To impart through knowledge in various latest measurement systems such as laser metrology, coordinate measuring machines and electro-optical devices. To train them in the area of precision and quality manufacturing					
Course Outcomes (CO): Student will be able to					
• Know the importance of the quality in their life and can make it as their habbit in all their activities.					
UNIT - I	**Quality value and Engineering**	Lecture Hrs:09			

An overall quality system, quality engineering in production design, quality engineering in design production processes		
UNIT - II	**Loss function and quality level**	Lecture Hrs: 09
Derivation and use of quadratile loss function, economic consequences of tightening tolerances as a means to improve quality, evaluations and types tolerances (N-type-, S-type and L-type)		
UNIT - III	**Tolerance Design and Tolerancing**	Lecture Hrs: 09
Functional limits, tolerance design for N-type, L-type and S-type characteristics, tolerance allocation for multiple components. **Parameter and tolerance design:** Introduction to parameter design, signal to noise ratios, parameter design strategy, Introduction to tolerance design, tolerance design using the loss function, identification of tolerance design factors.		
UNIT - IV	**Design of Experiments**	Lecture Hrs: 09
Introduction, Task aids and Responsibilities for DOE process steps, DOE process steps description. **Analysis of variance (ANOVA):** no-WAY ANOVA, One-way ANOVA, two-way ANOVA, Critique of F-test, ANOVA for four level factors, multiple level factors.		
UNIT - V	**Orthogonal Arrays**	Lecture Hrs: 09
Typical test strategies, better test strategies, efficient test strategies, conducting and analyzing an experiment. **Interpolation of experimental results:** Interpretation methods, percent contribution, estimating the mean **ISO-9000** Quality system, BDRE, 6-sigma, bench marking, quality circles-brain storming-fishbone diagram-problem analysis.		
Text Books:		
1. Taguchi techniques for quality engineering/Philip J.Ross / McGraw Hill Intl. 2nd Edition, 1995.		
Reference Books:		
1. Quality Engineering in Production systems/G.Taguchi, A.Elasayed et al/Mc.Graw Hill Intl. Edition, 1989. 2. Taguchi methods explained: Practical steps to Robust Design/Papan P.Bagchi/Prentice Hall Ind. Pvt. Ltd. New Delhi.		
Online Learning Resources:		
• https://quality-one.com/quality-engineering/ • https://en.wikipedia.org/wiki/Quality_engineering • https://youtu.be/5_hng9rgVHE • https://www.youtube.com/watch?v=oIG_NDb2g3U		

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- https://nptel.ac.in/courses/110/104/110104080/
- https://nptel.ac.in/courses/110/105/110105088/

Course Code	COMPUTER AIDED PROCESS PLANNING	L	T	P	C
21D04103c	Program Elective Course - II	3	0	0	3
	Semester	I			

Course Objectives: Student will be able

- To know the various steps involved in CAPP
- To classify the various methods of CAPP
- To understand the feature recognition in CAP
- Notable requirements for process planning systems are consistency, accuracy, and ease of application and completeness.

Course Outcomes (CO):

- Generate the structure of automated process planning system and uses the principle of generative and retrieval CAPP systems for automation
- Select the manufacturing sequence and explains the reduction of total set up cost for a particular sequence
- Predict the effect of machining parameters on production rate, cost and surface quality and determines

the manufacturing tolerances

- Explain the generation of tool path and solve optimization models of machining processes
- Create awareness about the implementation techniques for CAPP

UNIT - I	**Introduction to CAPP**	Lecture Hrs: 09

Information requirement for process planning system, Role of process planning, advantages of conventional process planning over CAPP, Structure of Automated process planning system, feature recognition, methods.
Generative CAPP system: Importance, principle of Generative CAPP system, automation of logical decisions, Knowledge based systems, Inference Engine, implementation, benefits.

UNIT - II	**Retrieval CAPP system**	Lecture Hrs: 09

Significance, group technology, structure, relative advantages, implementation, and applications **Selection of manufacturing sequence:** Significance, alternative manufacturing processes, reduction of total set-up cost for a particular sequence, quantitative methods for optimal selection, examples.

UNIT - III	**Determination of machining parameters**	Lecture Hrs: 09

Reasons for optimal selection of machining parameters, effect of parameters on production rate, cost and surface quality, different approaches, advantages of mathematical approach over conventional approach, solving optimization models of machining processes.

Determination of manufacturing tolerances: design tolerances, manufacturing tolerances, methods of tolerance allocation, sequential approach**,** integration of design and manufacturing tolerances, advantages of integrated approach over sequential approach

UNIT - IV	**Generation of tool path**	Lecture Hrs: 09

Simulation of machining processes, NC tool path generation, graphical implementation, determination of optimal index positions for executing fixed sequence, quantitative methods.

UNIT - V	**Implementation techniques for CAPP**	Lecture Hrs: 09

MIPLAN system, Computer programming languages for CAPP, criteria for selecting a CAPP system and benefits of CAPP. Computer integrated planning systems, and Capacity planning system.

Text Books:

1Automation , Production systems and Computer Integrated Manufacturing System –Mikell P.Groover
2..Computer Aided Design and Manufacturing – Dr.Sadhu Singh.

Reference Books:

1. Computer Aided Engineering – David Bedworth

Online Learning Resources:

- https://nptel.ac.in/courses/112/104/112104188/

- https://www.youtube.com/watch?v=20_K7c65Swg
- https://www.youtube.com/watch?v=y24meNZbUoU
- https://youtu.be/PRjExZxWsNc
- https://nptel.ac.in/courses/103/103/103103164/

Course Code	GEOMETRIC MODELLING LABORATORY	L	T	P	C
21D04104		0	0	4	2
	Semester	I			

Course Objectives: Student will be able

- To train the students with CAD packages
- To impart the 2D and 3D modeling skills to the students.
- To import and export different IGES files from one software to another

Course Outcomes (CO):

- Students will be able to design different parts of mechanical equipments
- Students will be able to apply their skills in various designing and Manufacturing Industries.

List of Experiments:

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M.TECH. IN CAD/CAM
COURSE STRUCTURE & SYLLABI

A – MODELLING

1.Generation of the following curves using "C" language

i. Bezier curves
ii. Splines
iii. B-Splines

2.Generation of the following surfaces using "C" language

i. Bezier surfaces
ii. B-Splines surfaces

3. Generation of solids using "C"

i. Constructive solid geometry
ii. Boundary representation

4. Typical tasks of Modeling using PRO/E,IDEAS, CATIA solid modeling packages

Surface modeling
Solid Modeling
Drafting and
Assembly Module

Course Code	FINITE ELEMENT ANALYSIS LABORATORY	L	T	P	C
21D04105		0	0	4	2
	Semester	I			

Course Objectives:

- Students should use the commercial software or programmes form the text-books or self-developed programs, to verify the results obtained by manual calculations. The input data and output results of the problem solved using the computer programs should be included in the Journal.

Course Outcomes (CO): Student will be able to

- Select appropriate element for given problem
- Select suitable meshing and perform convergence test
- Select appropriate solver for given problem
- Interpret the result
- Apply basic aspects of FEA to solve engineering problems

- Validate FEA solution

List of Experiments:

Finite Element Analysis using ANSYS 14.5 Package for different structures the discretization can be done with 1-D, 2-D & 3-D elements to perform the following analysis:

1. Static Analysis

a. Stress analysis of 2D truss.

b. Stress analysis of a plate with a circular hole and L-Bracket – 2D and 3D
c. Stress analysis of beams (cantilever, simply supported & fixed ends)

d. Stress analysis of an axi-symmetric component

2. Thermal and Fluid flow Analysis

a. Conductive heat transfer analysis of a 2D and 3D components
b. Convective heat transfer analysis of a 2D component

c. Coupled field analysis of a component

d. Determination of velocity of a fluid and volumetric flow rates for 1-D Fluid flow \

e. Determination of velocity of a fluid and volumetric flow rates for 2-D Fluid flow

3. Modal Analysis

a. mode frequency analysis of a 2D component

b. mode frequency analysis of beams (cantilever, simply supported, fixed ends)

4. Transient analysis

a. Transient analysis of a cantilever beam

5. FEM through MAT LAB

a. Introduction to MAT LAB

b. Analysis of 1-dimesional & 2D dimensional truss.

c. Analysis of 1-dimesional & 2D dimensional beam. d. Analysis of 1-dimesional & 2D dimensional heat conduction.

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Lab Manual

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M.TECH. IN CAD/CAM
COURSE STRUCTURE & SYLLABI

Course Code	**RESEARCH METHODOLOGY AND IPR**	**L**	**T**	**P**	**C**
21DRM101		**2**	**0**	**0**	**2**
	Semester		**I**		

Course Objectives:

- Identify an appropriate research problem in their interesting domain.
- Understand ethical issues understand the Preparation of a research project thesis report.
- Understand the Preparation of a research project thesis report
- Understand the law of patent and copyrights.
- Understand the Adequate knowledge on IPR

Course Outcomes (CO): Student will be able to

- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT - I		Lecture Hrs:

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, scope, and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT - II		Lecture Hrs:

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT - III		Lecture Hrs:

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT - IV		Lecture Hrs:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT - V		

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Textbooks:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"

2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”

Reference Books:

1. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”
2. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
3. Mayall, “Industrial Design”, McGraw Hill, 1992.
4. Niebel, “Product Design”, McGraw Hill, 1974.
5. Asimov, “Introduction to Design”, Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.

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M.TECH. IN CAD/CAM
COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED OPTIMIZATION TECHNIQUES	L	T	P	C
21D04201		3	0	0	3
	Semester	II			

Course Objectives: Student will be able to

- To understand the theory of optimization methods and algorithms developed for solving various types of optimization problems
- To develop and promote research interest in applying optimization techniques in problems of Engineering and Technology
- To apply the mathematical results and numerical techniques of optimization theory to concrete engineering problems.

Course Outcomes (CO): Student will be able to

- Understand importance of optimization of industrial process management
- Apply basic concepts of mathematics to formulate an optimization problem
- Analyse and appreciate variety of performance measures for various optimization problems

UNIT - I	INTRODUCTION AND ROBOT KINEMATICS	Lecture Hrs:09

Linear programming: Two-phase simplex method, Big-M method, duality, interpretation, applications. **Assignment problem**: Hungarian's algorithm, Degeneracy, applications, unbalanced problems, traveling salesman problem.

UNIT - II	ROBOT DRIVES AND CONTROL	Lecture Hrs: 09

Classical optimization techniques: Single variable optimization with and without constraints, multi – variable optimization without constraints, multi – variable optimization with constraints – method of Lagrange multipliers, Kuhn-Tucker conditions.

UNIT - III	ROBOT SENSORS	Lecture Hrs: 09

Numerical methods for optimization: Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method, types of penalty methods for handling constraints.

UNIT - IV	ROBOT CELL DESIGN AND APPLICATION	Lecture Hrs: 09

Genetic algorithm (GA) : Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA,
Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

UNIT - V	ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS	Lecture Hrs: 09

Dominated sorted GA, convergence criterion, applications of multi-objective problems .

Applications of Optimization in Design and Manufacturing systems: Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence
Text Books:
1. Optimal design – Jasbir Arora, Mc Graw Hill (International) Publishers 2. Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers 3. Engineering Optimization – S.S.Rao, New Age Publishers
Reference Books:
1.Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers 2. Genetic Programming- Koza 3. Multi objective Genetic algorithms - Kalyanmoy Deb, PHI Publishers

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M.TECH. IN CAD/CAM
COURSE STRUCTURE & SYLLABI

Course Code	INDUSTRIAL ROBOTICS & EXPERT SYSTEMS	L	T	P	C
21D04202		3	0	0	3
	Semester	II			

Course Objectives:

- To teach students the basics of robotics, construction features, sensor applications, robot cell design, robot programming and application of artificial intelligence and expert systems in robotics.

Course Outcomes (CO): Student will be able to

- Students are to the basics kinematics of robotics, and are able to understand the robot programming and also artificial intelligence and expert systems in robotics

UNIT - I	INTRODUCTION AND ROBOT KINEMATICS	Lecture Hrs:09

Definition need and scope of Industrial robots – Robot anatomy – Work volume – Precision movement – End effectors – Sensors. Robot Kinematics – Direct and inverse kinematics – Robot trajectories – Control of robot manipulators – Robot dynamics – Methods for orientation and location of objects.

UNIT - II	ROBOT DRIVES AND CONTROL	Lecture Hrs: 09

Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.

UNIT - III	ROBOT SENSORS	Lecture Hrs: 09

Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing –Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system.

UNIT - IV	ROBOT CELL DESIGN AND APPLICATION	Lecture Hrs: 09

Robot work cell design and control – Safety in Robotics – Robot cell layouts – Multiple Robots and machine interference – Robot cycle time analysis. Industrial application of robots.

UNIT - V	ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS	Lecture Hrs: 09

Methods of Robot Programming – Characteristics of task level languages lead through programming methods – Motion interpolation. Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – problem representation in AI – Problem reduction and solution techniques - Application of AI and KBES in Robots.

Text Books:

1. K.S. Fu, R.C. Gonzalez and C.S.G. Lee, “Robotics Control, Sensing, Vision and Intelligence”, Mc Graw Hill, 1987

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2. Yoram Koren,” Robotics for Engineers’ Mc Graw-Hill, 1987

Reference Books:

1. Kozyrey, Yu. “Industrial Robots”, MIR Publishers Moscow, 1985.
2. Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, “Robotics Engineering – An Integrated Approach”, Prentice-Hall of India Pvt. Ltd., 1984.
3. Deb, S.R.” Robotics Technology and Flexible Automation”, Tata Mc Graw-Hill, 1994.
4. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey,” Industrial Robotics Technology, Programming and Applications”, Mc Graw-Hill, Int. 1986.
5. Timothy Jordanides et al ,”Expert Systems and Robotics “, Springer –Verlag, New York, May 1991.

Online Learning Resources:

- https://freevideolectures.com/course/4560/nptel-mechanism-robot-kinematics
- https://see.stanford.edu/course/cs223a
- https://cosmolearning.org/courses/introduction-to-robotics/video-lectures/
- https://www.youtube.com/watch?v=0yD3uBshJB0
- https://nptel.ac.in/courses/112/105/112105236/
- https://www.youtube.com/watch?v=xrwz9IxpMJg
- https://www.coursehero.com/file/59785981/Lecture-9-Robot-cell-designppt/
- https://www.plantautomation-technology.com/articles/different-types-of-robot-programming-languages

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M.TECH. IN CAD/CAM
COURSE STRUCTURE & SYLLABI

Course Code	CNC TECHNOLOGY & PROGRAMMING	L	T	P	C
21D04203a	Program Elective Course - III	3	0	0	3
	Semester	II			

Course Objectives: Student will be able to study

- Safety in the CNC environment
- CNC Machine Tools compared to Manual Machine tools
- Repeatability and Speed is the Key to CNC C. Programming
- Manual Programming
- CAD/CAM Programming CNC Lathe 1. Uses 2. Setups 3. Tooling 4. CNC Lathe Project
- CNC Mill a. Uses b. Setups c. Tooling d. CNC Mill Project Course Topic

Course Outcomes (CO): Student will be able to

Upon completion of this course, the student will be able to:

- Understand the basic procedures and concepts of programming, set up and operation of a
- CNC Machining Centre.
- Identify and understand the basic programming codes.
- Create geometry and tool paths from the specifications on a blueprint for simple parts using
- Master cam programming software.
- Identify and define the functions of the CNC machine control.
- Set up the CNC machining center for manufacturing simple parts
- Manufacture simple parts on the CNC machining center.

UNIT - I	Introduction to CNC Machine tools	Lecture Hrs: 09

Evolution of Computerized control in manufacturing, Components, Working principle of CNC, DNC and Machining centers.
Constructional features of CNC machine tools: Introduction, Spindle drives, Transmission belting, axes feed drives, Slide ways, Ball screws.
Accessories: Work tables, Spindles, Spindle heads, Beds and Columns, Tooling – Automatic Tool changer (ATC).

UNIT - II	Feedback devices	Lecture Hrs: 09

Introduction, Digital incremental displacement measuring systems, Incremental rotary encoders, Moire fringes, Digital absolute measuring system.
Electro-magnetic analogue position transducers: Principle, advantages, characterstics, Synchros, Synchro-Resolvers, Inductos, Laser interferometer.

UNIT - III	Control Systems and interface	Lecture Hrs: 09

Open and closed loop systems, Micro processor based CNC systems, block diagram of typical CNC system, description of hard ware and soft interpolation systems, Standard and optional features of CNC control systems.

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UNIT - IV	**APT programming**	Lecture Hrs: 09
APT language structure, APT geometry, Definition of point, time, vector, circle, plane, patterns and matrices. APT motion commands: setup commands, point-to point motion commands, continuous path motion commands, post processor commands, control commands, Macro subroutines, Part programming preparation for typical examples.		
UNIT - V	**Economics and Maintenance of CNC machine tools**	Lecture Hrs: 09
Introduction, factors influencing selection of CNC machines, Cost of operation of CNC machines, Maintenance features of CNC machines, Preventive maintenance, Documentation, Spare parts, Training in Maintenance.		

Text Books:

1.Computer Numerical Control Machines – Dr. Radha Krishnanan, New Central Book Agency

2. Computer Numerical Control Machines – Hans B. Keif and T. Frederick Waters Macmillan/McGraw Hill.

Reference Books:

1.CNC Machines – B.S. Aditahn and Pabla

2. CNC Machining technology – Springer – Verlag

3. Computer Numerical Machine tools - G.E. Thyer, NEWNES

Online Learning Resources:

- https://nptel.ac.in/courses/112/105/112105211/
- https://academy.titansofcnc.com/files/Fundamentals_of_CNC_Machining.pdf
  http://home.iitk.ac.in/~nsinha/CNC.pdf
- https://www.thomasnet.com/articles/custom-manufacturing-fabricating/understanding-cnc-machining/
- https://www.hubs.com/knowledge-base/cnc-machining-manufacturing-technology-explained/
- https://www.youtube.com/watch?v=P0BvBbQoiok
- https://www.youtube.com/watch?v=bfTQVixviAo
- https://en.wikipedia.org/wiki/APT_(programming_language)

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M.TECH. IN CAD/CAM
COURSE STRUCTURE & SYLLABI

Course Code	COMPUTER GRAPHICS	L	T	P	C
21D04203b	Program Elective Course - III	3	0	0	3
	Semester	II			

Course Objectives:

- The students can understand the Basics of computer Graphics like drawing line, arc etc., Drawing of spline curves, Creation of surfaces, Algorithms for 3D viewing, Available drawing standards.

Course Outcomes (CO): Student will be able to understand

- Basics of computer Graphics like drawing line, arc etc.
- Drawing of spline curves
- Creation of surfaces
- Algorithms for 3D viewing
- Available drawing standards
- Basics of computer Graphics like drawing line, arc etc.

UNIT - I	Introduction to computer graphics	Lecture Hrs: 09

Color CRT raster scan monitors, plasma display & liquid crystal display monitors, computer input devices, hard copy devices.
Raster scan graphics: Line drawing algorithms – DDA & Bresenham algorithms, circle generation, general function rasterization, displaying lines, characters and polygons.

UNIT - II	Filling algorithms	Lecture Hrs: 09

polygon filling, edge fill algorithm, seed fill algorithm, fundamentals of antialiasing and half toning.

UNIT - III	Line CLIPPING	Lecture Hrs: 09

Simple visibility algorithm, Cohen-Sutherland subdivision line clipping algorithm, mid point sub division algorithm.
Polygon clipping: polygon clipping, reentrant polygon clipping – Sutherland – Hodgeman algorithm, character clipping, 3D- clipping.

UNIT - IV	Transformations	Lecture Hrs: 09

Cartesian and homogeneous coordinate systems two dimensional and three dimensional transformations – scaling, rotation, Shearing, Zooming, viewing transformation, reflection, rotation about an axis, concatenation.

UNIT - V	Rendering	Lecture Hrs: 09

Hidden line removal algorithms, surface removal algorithms, painters, Warnock, Z-buffer algorithm.
Shading algorithms: Constant intensity algorithm, Phong's shading algorithm, gourand shading algorithm, Comparison of shading algorithms.

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Text Books:

1. Procedural elements for computer graphics-D.F.Rogers, Tata McGraw-Hill.
2. Computer Graphics-Donald Hearn & M.P. Bakers.

Reference Books:

1. Computer graphics-Harrington.

Online Learning Resources:

- https://lecturenotes.in/subject/59/computer-graphics-cg
- https://www.dgp.toronto.edu/~hertzman/418notes.pdf
- http://www2.cs.uidaho.edu/~jeffery/courses/324/lecture.html
- http://personal.ee.surrey.ac.uk/Personal/J.Collomosse/pubs/cm20219.pdf
- http://www.svecw.edu.in/Docs%5CCSECGLNotes2013.pdf
- https://www.youtube.com/watch?v=fwzYuhduME4
- https://nptel.ac.in/courses/106/103/106103224/
- https://nptel.ac.in/courses/106/102/106102065/

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M.TECH. IN CAD/CAM
COURSE STRUCTURE & SYLLABI

Course Code	GLOBAL INTEGRATED MANUFACTURING	L	T	P	C
21D04203c	Program Elective Course - III	3	0	0	3
	Semester	II			

Course Objectives: Student will be able to understand

- Globaly Emphasizes the integration of manufacturing enterprise using computer-
- integrated manufacturing (CIM) technologies.
- It employs CAD/CAM interface and
- other CIMsubsystems, database management, facility layout, Grouptechnology, teamwork, and manufacturing operations.

Course Outcomes (CO): Student will be able to

- Develop an understanding of computer-integrated manufacturing (CIM) and its impact on productivity, product cost, and quality.
- Obtain an overview of computer technologies including computers, database and data collection, networks, machine control, etc, as they apply to factory management and factory floor operations.
- Describe the integration of manufacturing activities into a complete system.

UNIT - I	INTRODUCTION	Lecture Hrs: 09

Evolution of manufacturing, CAD/CAM and CIM – Globalization - Scope of CIM - Segments of generic CIM, computers and workstations, an overview of CIM software. World class manufacturing and its importance.

UNIT - II	GLOBAL MANUFACTURING ENTERPRISE	Lecture Hrs: 09

Global manufacturing revolution – Reconfigurable machine – Reconfigurable manufacturing system - Production design for globalization – Location of manufacturing plants – Global business strategies – Global strategic alliance – IT-based enterprise – Information transfer in manufacturing systems - PRIDE – Competitive advantage: Logistics – Strategic sourcing - Supply chain - The dilemma of globalization – Where manufacturing enterprises heading?

UNIT - III	INTERNATIONAL LOGISTICS	Lecture Hrs: 09

Introduction – supply chain background - outbound logistics functions – inbound logistics functions – overall logistics activities – logistics intermediates. Economic importance. Logistics media: ocean ships (cargo types), air transportation, surface transportation. Terms of sale and payment. Documentation and insurance: cargo, hull, air, land transport – settlement of insurance – claims. Famine relief logistics – demand forecasting – sourcing models – packaging – managing inventories - site/route selection – warehousing and storage.
INTERNAL SOURCING: Introduction – why sourcing is global? – design of global sourcing system – global sourcing and procurement – issues in import and export.
FUTURE ISSUES IN INTERMEDIATE LOGISTICS: Overview – increase use of world-class logistics practices – multi-country trade alliances – one stop shopping concept – amodalism – environmental concerns – space transportation and exploration – The internet.

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UNIT - IV	CNC TECHNOLOGY AND ROBOTIC SYSTEMS	Lecture Hrs: 09

Principles of numerical control, types of CNC machines, features of CNC systems, programming techniques, capabilities of a typical NC, CAM software, integration of CNC machines in CIM environment, DNC – FMS – objectives – components – FMS layout configurations – FMS classification – ERP. Material handling systems – basics and advanced: conveyor analysis, AGV analysis. Warehousing – storage and retrieval systems: AS/RS analysis. Overview of JIT. Robotic systems-types of robots and their performance capabilities, programming of robots, hardware of robots, kinematics of robots, product design for robotized manufacturing, applications of robots in manufacturing and assembly. Process planning, variant and generative process planning methods – manual vs CAPP - AI in process planning.

UNIT - V	MANUFACTURING SYSTEM SOFTWARE	Lecture Hrs: 09

CIM architecture - Production management system (PMS) - forecasting, master production schedule, MRP, capacity planning, shop floor control (SFC), factory data collection system (FDS) – Automatic data capture (ADC) method and its techniques – Bar code – types of bar codes – Data acquisition system - inventory management, product routing, job costing, marketing applications – Applications of ADC - Basics of networking concepts, networking devices.
VIRTUAL ORGANISATION: Paperless factory – Mobile office - Introduction of virtual reality and application - Virtual prototyping – Virtual manufacturing - Virtual instrumentation and measurement - Virtual enterprises.

Text Books:

1. Donal F Wood, Anthony P Barone, Paul R Murthy and Daniel L Wardlow, “International logistics”, AMACOM, 2007.
2. Voram Koren, “The Global Manufacturing Revolution: Product – Process – Business Integration and Reconfigurable Systems”, Kindle Edition, 2011.
3. Mikell P Groover, “Automation of Production Systems and Computer Integrated Manufacturing”, Pearson Education, New Delhi, 2001.

Reference Books:

1. Lee Kunwoo, “CAD/CAM/CAE Systems”, Addition, Wesley, USA, 1999.
2. Kant Vajpayee S, “Principles of Computer Integrated Manufacturing”, Prentice Hall, India, New Jersey, 2003.
3. Radha krishnan P, Subramanyan S and Raju V, “CAD/CAM/CIM”, New Age International Pvt. Ltd, New Delhi,

Online Learning Resources:

- https://nptel.ac.in/courses/112/104/112104289/
- https://nptel.ac.in/courses/112/105/112105249/
- https://www.youtube.com/watch?v=lRm9GiGoZKg
- https://osme.co.in/wp-content/uploads/2020/05/6TH-SEM-MECHANICAL-ENGG-Advance-manufacturing-and-CAD-CAM.pdf
- https://www.cet.edu.in/noticefiles/259_Lecturer%20Note%20on%20Mechatronics-ilovepdf-compressed.pdf

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COURSE STRUCTURE & SYLLABI

Course Code	MECHATRONICS APPLICATIONS IN MANUFACTURING (PE-IV)	L	T	P	C
21D04204a		3	0	0	3
	Semester	II			

Course Objectives: Student will be able to

- Understand architecture of the mechatronics system design and characteristics of sensors and actuators and their selection for mechatronic systems.
- Learn the basic concepts of microprocessor, microcontroller and PLC used in mechatronics system.
- Learn underlying concepts of MEMS and its applications in micro-manufacturing.

Course Outcomes (CO): At the end of the course the students shall be able to

- Interface sensor and actuator for a mechatronic system.
- Indigenously design and develop a mechatronic system.
- Design and develop MEMS for various industrial applications.

UNIT - I	INTRODUCTION	Lecture Hrs: 09

Introduction to Mechatronics - Systems - Mechatronics in Products - Measurement Systems - Control Systems - Traditional design and Mechatronics Design.

UNIT - II	SENSORS AND TRANSDUCERS	Lecture Hrs:09

Introduction - Performance Terminology - Displacement, Position and Proximity - Velocity and Motion - Fluid pressure - Temperature sensors - Light sensors - Selection of sensors – Signal processing - Servo systems.

UNIT - III	MICROPROCESSORS IN MECHATRONICS	Lecture Hrs: 09

Introduction - Architecture - Pin configuration - Instruction set - Programming of Microprocessors using 8085 instructions - Interfacing input and output devices - Interfacing D/A converters and A/D converters – Applications - Temperature control - Stepper motor control - Traffic light controller.

UNIT - IV	PROGRAMMABLE LOGIC CONTROLLERS	Lecture Hrs: 09

Introduction - Basic structure - Input / Output processing - Programming -Mnemonics Timers, Internal relays and counters - Data handling - Analog input / output - Selection of PLC.

UNIT - V	DESIGN AND MECHATRONICS	Lecture Hrs: 09

Designing - Possible design solutions - Case studies of Mechatronics systems.

Text Books:

1. Michael B.Histand and David G. Alciatore, " Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 1999.

2. Bradley, D.A., Dawson, D, Buru, N.C. and Loader, AJ, "Mechatronics ", Chapman and Hall, 1993.
3. Ramesh.S, Gaonkar, "Microprocessor Architecture, Programming and Applications" Wiley Eastern, 1998.

Reference Books:

1. Lawrence J.Kamm, " Understanding Electro-Mechanical Engineering, An Introduction to Mechatronics ", Prentice-Hall, 2000.
2. Ghosh, P.K. and Sridhar, P.R., 0000 to 8085, "Introduction to Microprocessors for Engineers and Scientists ", Second Edition, Prentice Hall, 1995.

Online Learning Resources:

- https://www.cet.edu.in/noticefiles/259_Lecturer%20Note%20on%20Mechatronics-ilovepdf-compressed.pdf
- https://lecturenotes.in/subject/137/mechatronics-mech
- http://engineering.nyu.edu/mechatronics/Control_Lab/Criag/Craig_RPI/2001/Mechatronics%20Lecture%20Notes.htm
- https://jcboseust.ac.in/mechanical/images/mtech1stsem/mechatronics_product_design.pdf
- https://www.youtube.com/watch?v=tAkkUNEknGk
- https://nptel.ac.in/courses/112/107/112107298/
- https://www.youtube.com/watch?v=ncSnIkBO-X0

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M.TECH. IN CAD/CAM
COURSE STRUCTURE & SYLLABI

Course Code	RAPID PROTOTYPING	L	T	P	C
21D04204b	Program Elective Course - IV	3	0	0	3
	Semester	II			

Course Objectives:

- At the end of this course the students would have developed a thorough understanding of the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Rapid Prototyping Technologies.

Course Outcomes (CO): Student will be able to

- It helps the students to get familiarized with the various methods of rapid prototyping technologies and rapid tooling.

UNIT - I	Introduction	Lecture Hrs:09

Need for the compression in product development, History of RP system, Survey of applications, Growth of RP industry and classification of RP system.
Stereo Lithography System: Principle, Process parameter, Process details, Data preparation, Data files and machine details, Applications.

UNIT - II	Fusion Decomposition Modeling	Lecture Hrs:09

Principle, process parameter, Path generation, Applications.
Solid ground curing: Principle of operation, Machine details, Applications,

UNIT - III	Laminated Object Manufacturing	Lecture Hrs:09

Principle of Operation, LOM materials, Process details, Applications.
Concepts Modelers: Principle, Thermal jet printer, Sander's model market, 3-D printer, Genisys Xs printer HP system 5, Object Quadra system.

UNIT - IV	LASER ENGINEERING NET SHAPING (LENS)	Lecture Hrs:09

Rapid Tooling: Indirect Rapid tooling- Silicon rubber tooling- Aluminum filled epoxy tooling Spray metal tooling, Cast kriksite, 3Q keltool, etc, Direct Rapid Tooling Direct. AIM, Quick cast process, Copper polyamide, Rapid Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling soft, Tooling vs. hard tooling.

Software for RP: STL files, Overview of Solid view, magics, imics, magic communication, etc. Internet based software, Collaboration tools.

UNIT - V	Rapid Manufacturing Process Optimization	Lecture Hrs:

Factors influencing accuracy, Data preparation error, Part building error, Error in finishing, Influence of build orientation.

Text Books:

1.“ stereo lithography and other RP & M Technologies”, Paul F.Jacobs, SME, NY 1996
2. “ Rapid Manufacturing **”,** Flham D.T & Dinjoy S.S, Verlog London 2001

Reference Books:

1. Rapid automated”, Lament wood, Indus Press New York.

Online Learning Resources:

- https://www.hubs.com/knowledge-base/introduction-fdm-3d-printing/
- https://slideplayer.com/slide/6927137/
- https://www.mdpi.com/2073-4360/12/6/1334
- https://www.centropiaggio.unipi.it/sites/default/files/course/material/2013-11-29%20-%20FDM.pdf
- https://lecturenotes.in/subject/197
- https://www.cet.edu.in/noticefiles/258_Lecture%20Notes%20on%20RP-ilovepdf-compressed.pdf
- https://www.vssut.ac.in/lecture_notes/lecture1517967201.pdf
- https://www.youtube.com/watch?v=NkC8TNts4B4

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M.TECH. IN CAD/CAM
COURSE STRUCTURE & SYLLABI

Course Code	ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS (PE-IV)	L	T	P	C
21D04204c		3	0	0	3
	Semester	II			

Course Objectives:

- The student should be made to study the concepts of Artificial Intelligence. 1.Learn the methods of solving problems using Artificial Intelligence.
- Introduce the concepts of Expert Systems and machine learning.

Course Outcomes (CO): Student will be able to

- Identify problems that are amenable to solution by AI methods.
- Identify appropriate AI methods to solve a given problem.
- Formalise a given problem in the language/framework of different AI methods.
- Implement basic AI algorithms.
- Design and carry out an empirical evaluation of different algorithms on a problem formalisation, and state the conclusions that the evaluation supports.

UNIT - I	Artificial Intelligence	Lecture Hrs:09

Introduction, definition, underlying assumption, Important of Al, Al & related fields State space representation, defining a problem, production systems and its characteristic, search and control strategies –Introduction, preliminary concepts, examples of Search , problems.
Uniformed or preliminary Concept: Examples of search problems, Uniformed or Blind Search, Informed Search, Or Graphs, Heuristic Search techniques- Generate and Test, Hill climbing, Best first search, Problem reduction, Constraint satisfaction, Means- Ends Analysis.

UNIT - II	Knowledge Representation Issues	Lecture Hrs: 09

Representations and Mapping, Approaches, Issues in Kr, Types of knowledge procedural Vs Declarative, Logic programming, Forward Vs Backward reasoning, Matching, Non monotonic reasoning and it logic.
Use of Predicate Logic: Representing simple facts, Instance and is a relationships, Syntax and Semantics for Propositional logic, FOPL, and properties of Wffs, conversion to casual form, Resolution, Natural deduction.

UNIT - III	Statistical and Probabilistic Reasoning	Lecture Hrs: 09

Symbolic reasoning under uncertainly, Probability and Bayes theorem, Certainty factors and Rule based systems, Bayesian Networks, Dempster- Shafer Theory, Fuzzy Logic.

UNIT - IV	Expert Systems	Lecture Hrs: 09

Introduction, Structure and uses, Representing and using domain knowledge, Expert System Shells. Pattern recognition, introduction, Recognition and classification process, learning classification patterns, recognizing and understanding speech.
Introduction to Knowledge Acquisition: Types of learning, General learning model, and

performance measures.

UNIT - V	**Typical Expert Systems**	Lecture Hrs: 09

MYCIN, Variants of MYCIN, PROSPECTOR DENDRAL, PRUFF etc.
Introduction to Machine Learning: Perceptons, Checker Playing examples, Learning, Automata, Genetic Algorithms, Intelligent Editors.

Text Books:

1. " Artificial Intelligence" , Elaine Rich & Kevin Knight,M/H 1983
2. "Artificial Intelligence in Business", Wendry B.Ranch, Science & Industry –Vol -II application, Ph 1985.
3. " A Guide to Expert System" Waterman, D.A., Addison,– Wesley inc. 1986.

Reference Books:

1. "Building expert system" Hayes, Roth, Waterman, D.A (ed), AW 1983.
2. "Designing Expert System", S.M. and Kulliknowske Weis, London Champion Hull 1984.

Online Learning Resources:

- https://www.youtube.com/watch?v=11nzrNkn9D8
- https://www.youtube.com/watch?v=BXHcPESoaPY
- https://silo.tips/download/module-9-lecture-notes-5-expert-systems
- https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_expert_systems.htm
- https://epub.uni-regensburg.de/13629/1/ubr06078_ocr.pdf
- https://lecturenotes.in/subject/879/artificial-intelligence-and-expert-system
- https://www.vssut.ac.in/lecture_notes/lecture1530018613.pdf
- https://www.cet.edu.in/noticefiles/271_AI%20Lect%20Notes.pdf

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M.TECH. IN CAD/CAM
COURSE STRUCTURE & SYLLABI

Course Code	**PROCESS AUTOMATION LABORATORY**	**L**	**T**	**P**	**C**
21D04205		**3**	**0**	**0**	**3**
	Semester	**II**			

Course Objectives: Student will be able to

To review and train in CAD modeling.
To train on various areas of finite element analysis of mechanical components.
CAM lab
To train on part programming and program generation from a CAD model.
To train on machining in various CNC machines.
To train on various modern measuring instruments.

Course Outcomes (CO): Student will be able to

Students will be able to review and train in CAD modeling.
Students will be get trained on various areas of finite element analysis of mechanical components.
Students would get trained on part programming and program generation from a CAD model•
Students would get trained on machining in various CNC machines, Students would get trained on various modern measuring instruments.

List of Experiments:

1. Aristo XT Six axis Robot
   a. Introduction to Robot programming
   b. Robot programming exercises (Point-to-Point and continuous path task)

2. Either Online / Offline mode.
   a. Simulation of a manufacturing system for increasing production rate.
   b. Simulation of a simple automation system.

3. Either Online / Offline mode.
   I. Hydraulic Circuits
      a. Introduction to Automation studio & its control
      b. Draw & Simulate the Hydraulic circuit for series & parallel cylinders connection
      c. Draw & Simulate Meter-in, Meter-out and hydraulic press and clamping.
      d. Sequencing circuits in hydraulics.
      e. Synchronizing circuits in hydraulics.
   II. Pneumatic circuits
      a. Sequencing circuits in Pneumatics.
      b. Synchronizing circuits in Pneumatics.
      c. Design and Simulation of simple pneumatic circuit by using Cascade Method.
      d. Design and Simulation of simple pneumatic circuit by using step counter method
4. Additive manufacturing machine
   a. Introduction to Additive manufacturing Machine.
   b. Design and fabrication of simple symmetrical and unsymmetrical components

Text Books: Lab Manual

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M.TECH. IN CAD/CAM
COURSE STRUCTURE & SYLLABI

Course Code	CAM LAB	L	T	P	C
21D04206		3	0	0	3
	Semester	II			

Course Objectives: Student will be able to

- To get practical knowledge on manual part programming of CNC lathe machine by using G codes and M codes.
- To get practical knowledge on manual part programming of CNC milling and drilling machine by using G• codes and M codes.
- To get the practical knowledge on APT language.•

Course Outcomes (CO):

- Upon successful completion students should be able to:
- Use an understanding of General and Machine (G& M) code to generate or edit a program which will operate a CNC Lathe.
- Apply mathematical methods to calculate Cartesian coordinates

List of Experiments:

1. Manual part programming (using G and M codes) in CNC Lathe Machine
   (a) Part programming for linear interpolation, circular interpolation, chamfering and grooving.
   (b) Part programming by using standard canned cycles for facing, turning, taper turning and thread cutting.
2. Manual part programming (using G and M codes) in CNC Milling Machine
   (a) Part programming for linear interpolation, circular interpolation and contour motions.
   (b) Part programming involving canned cycles for drilling peak drilling and boring.
3. APT (Automatically Programmed Tools) language in CNC Milling and Lathe machine.
4. Cutting tool path generation using any one simulation package for different machining operation

Text Books: Lab Manual

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COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED TOOL DESIGN	L	T	P	C
21D04301a	Program Elective Course - V	3	0	0	3
	Semester	III			

Course Objectives:
The purpose of this course is to make the students to get familiarized with the design of various tools that can be implemented for different mechanical operations.

Course Outcomes (CO):
It helps the students to get familiarized with advanced tool design for various mechanical operations which includes cutting, jigs and fixtures, press tool dies and modern CNC machine tools.

UNIT - I	INTRODUCTION TO TOOL DESIGN	Lecture Hrs: 09

Introduction –Tool Engineering – Tool Classifications– Tool Design Objectives – Tool Design in manufacturing- Challenges and requirements- Standards in tool design-Tool drawings -Surface finish – Fits and Tolerances - Tooling Materials- Ferrous and Non ferrous Tooling Materials- Carbides, Ceramics and Diamond -Non metallic tool materials-Designing with relation to heat treatment.

UNIT - II	DESIGN OF CUTTING TOOLS	Lecture Hrs: 09

Mechanics of Metal cutting –Oblique and orthogonal cutting- Chip formation and shear angle - Single-point cutting tools – Milling cutters – Hole making cutting tools- Broaching Tools - Design of Form relieved and profile relieved cutters-Design of gear and thread milling cutters.

UNIT - III	DESIGN OF JIGS AND FIXTURES	Lecture Hrs: 09

Introduction – Fixed Gages – Gage Tolerances –selection of material for Gages – Indicating Gages – Automatic gages – Principles of location – Locating methods and devices – Principles of clamping – Drill jigs – Chip formation in drilling – General considerations in the design of drill jigs – Drill bushings – Methods of construction –Thrust and Turning Moments in drilling - Drill jigs and modern manufacturing- Types of Fixtures – Vise Fixtures – Milling Fixtures – Boring Fixtures – Broaching Fixtures – Lathe Fixtures – Grinding Fixtures – Modular Fixtures – Cutting Force Calculations.

UNIT - IV	DESIGN OF PRESS TOOL DIES	Lecture Hrs: 09

Types of Dies –Method of Die operation–Clearance and cutting force calculations- Blanking and Piercing die design – Pilots – Strippers and pressure pads- Presswork materials – Strip layout – Short-run tooling for Piercing – Bending dies – Forming dies – Drawing dies-Design and drafting.

UNIT - V	TOOL DESIGN FOR CNC MACHINE TOOLS	Lecture Hrs: 09

Introduction –Tooling requirements for Numerical control systems – Fixture design for CNC machine tools- Sub plate and tombstone fixtures-Universal fixtures– Cutting tools– Tool holding methods– Automatic tool changers and tool positioners – Tool presetting– General explanation of the Brown and Sharp machine.

Text Books:
1. Cyrll Donaldson, George H.LeCain, V.C. Goold, "Tool Design", Tata McGraw Hill Publishing Company Ltd., 2000.
2. E.G.Hoffman," Jig and Fixture Design", Thomson Asia Pvt Ltd, Singapore, 2004.

Reference Books:
1. Prakash Hiralal Joshi, "Tooling data", Wheeler Publishing, 2000
2. Venkataraman K., "Design of Jigs, Fixtures and Presstools", TMH, 2005

3. Haslehurst M., “Manufacturing Technology”, The ELBS, 1978.
Online Learning Resources:
https://www.iare.ac.in/sites/default/files/lecture_notes/TOOL%20DESIGN_Lecture_Notes.pdf https://www.cet.edu.in/noticefiles/261_MMP%20Lecture%20Notes-ilovepdf-compressed.pdf https://www.vssut.ac.in/lecture-notes.php?url=production-engineering https://nptel.ac.in/courses/112/105/112105233/ https://www.youtube.com/watch?v=7MkX-sW97rI https://nptel.ac.in/courses/112/105/112105126/# https://youtu.be/7yzvno4AvKw

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M.TECH. IN CAD/CAM
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Course Code	DESIGN FOR MANUFACTURING	L	T	P	C
21D04301b	Program Elective Course - V	3	0	0	3
	Semester	III			

Course Objectives: Student will be able to

- Internalize the attributes along which the success or failure of a manufacturing process, machine, or system will be measured: quality, cost, rate and flexibility.
- Provide exposure to a range of current industrial processes and practices used to manufacture products in high and low volumes. Focus in depth on a few selectedprocesses.
- Understand the factors that control the rate of production and influence the quality, cost and flexibility of processes.
- Understand the impact of manufacturing constraints on product design and processplanning.
- Apply an understanding of variation to the factors that control the production rate and influence the quality, cost and flexibility of processes and systems.

Course Outcomes (CO): Student will be able to

- Manufacturing is how we satisfy human need and create wealth. The challenge is to create a product that is responsive to the customer with high quality and low cost. A graduate should have the tools and confidence to go into a manufacturing enterprise that is using an unfamiliar process to make a product he/she has not seen, and yet be able to make intelligent decisions.

UNIT - I		Lecture Hrs:09

Introduction: Design philosophy-steps in design process-general design rules for manufacturability-basic principles of designing for economical production-creativity in design.

Materials: Selection of materials for design-developments in material technology-criteria for material selection-material selection interrelationship with process selection-process selection charts.

UNIT - II		Lecture Hrs: 09

Machining processes: Overview of various machining processes-general design rules for machining-dimensional tolerance and surface roughness-Design for machining – ease – redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

UNIT - III		Lecture Hrs: 09

Metal casting: Appraisal of various casting processes, selection of casting process,-general design considerations for casting-casting tolerance-use of solidification, simulation in casting design- product design rules for sand casting.

UNIT - IV		Lecture Hrs: 09

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Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines-pre and post treatment of welds-effects of thermal stresses in weld joints-design of brazed joints.

Forging: Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.

UNIT - V		Lecture Hrs: 09

Extrusion & Sheet metal work: Design guide lines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking.

Plastics: Visco elastic and creep behavior in plastics-design guidelines for plastic components- design considerations for injection moulding

Textbooks:

1. Design for manufacture, John cobert, Adisson Wesley. 1995
2. Design for Manufacture by Boothroyd,

Reference Books

1. ASM Hand book Vol.20

Online Learning Resources:

- https://nptel.ac.in/courses/112/101/112101005/
- https://www.iare.ac.in/sites/default/files/lecture_notes/DFMA_LECTURE_NOTES.pdf
- https://ocw.mit.edu/courses/mechanical-engineering/2-008-design-and-manufacturing-ii-spring-2004/lecture-notes/
- https://dokumen.tips/documents/design-for-manufacturing-and-assembly-1-lecture-notes-on-design-for-manufacturing.html
- https://www.youtube.com/watch?v=ofmbhbVCUqI
- https://onlinecourses.nptel.ac.in/noc21_me66/preview

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Course Code	COMPUTER AIDED TOOLS FOR MANUFACTURING	L	T	P	C
21D04301c	Program Elective Course - V	3	0	0	3
	Semester	III			

Course Objectives:

- The purpose of this course is to make the students to get familiarized with various computer aided tools that can be implemented in various industrial applications.

Course Outcomes (CO): Student will be able to

- It helps the students to get familiarized with computer aided tools for various industrial applications which includes manufacturing, process planning, inspection, data management and reverse engineering.

UNIT - I	COMPUTER AIDED MANUFACTURING	Lecture Hrs:09

Manufacturing Processes – Removing, Forming, Deforming and joining – Integration Requirements. Integrating CAD, NC and CAM – Machine tools – Point to point and continuous path machining, NC, CNC and DNC – NC Programming – Basics, Languages, G Code, M Code, APT – Tool path generation and verification – CAD/CAM NC Programming – Production Control – Cellular Manufacturing.

UNIT - II	COMPUTER AIDED PROCESS PLANNING	Lecture Hrs:09

Role of process planning in CAD/CAM Integration – Computer Aided Process Planning – Development, Benefits, Model and Architecture – CAPP Approaches – Variant, Generative and Hybrid – Process and Planning systems – CAM-I, D-CLASS and CMPP – Criteria in selecting a CAPP System.

UNIT - III	COMPUTER AIDED INSPECTION	Lecture Hrs:09

Engineering Tolerances – Need for Tolerances – Conventional Tolerances – FITS and LIMITS – Tolerance Accumulation and Surface quality – Geometric Tolerances – Tolerances Practices in design, Drafting and manufacturing – Tolerance Analysis – Tolerance synthesis – Computer Aided Quality control – Contact Inspection Methods – Non Contact Inspection Methods – Non optical.

UNIT - IV	REVERSE ENGINEERING	Lecture Hrs:09

Scope and tasks of Reverse Engineering – Domain Analysis – Process Duplicating – Tools for RE – Developing Technical data – Digitizing techniques – Construction of surface model – Solid part model – Characteristic evaluation – Software's and its application – CMM and its feature capturing – surface and solid modeling.

UNIT - V	DATA MANAGEMENT	Lecture Hrs:09

Strategies for Reverse Engineering Data management – Software application – Finding renewable software components – Recycling real time embedded software – Design experiments to evaluate a RE tools – Rule based detection for RE user interface – RE of assembly programs.

Text Books:

1. Ibrahim Zeid and R. Sivasubramanian, "CAD/CAM Theory and Practice", Revised First special Indian Edition, Tata Mc Graw Hill Publication, 2007
2. Catherine A. Ingle, "Reverse Engineering", Tata Mc Graw Hill Publication, 1994
3. Ibrahim Zeid, "Mastering CAD/CAM", special Indian Edition, Tata Mc Graw Hill Publication, 2007.

Reference Books:

1. David D. Bedworth, Mark R. Henderson, Philp M. Wolfe, "Computer Integrated Design and manufacturing", Mc Graw Hill International series, 1991
2. Linda Wills, "Reverse Engineering" Kluwer Academic Press, 1996
3. Donald R. Honra, "Co-ordinate measurement and reverse Engineering, American Gear Manufacturers Association.

Online Learning Resources:

- https://www.autodesk.com/products/fusion-360/blog/computer-aided-manufacturing-beginners/
- https://www.youtube.com/watch?v=EgKc9L7cbKc
- https://nptel.ac.in/courses/112/105/112105211/
- https://lecturenotes.in/subject/409/computer-aided-design-and-manufacturing-cadm
- https://www.youtube.com/watch?v=9dd3M2a4LKI
- https://www.iare.ac.in/sites/default/files/lecture_notes/CAD_CAM_LECTURE%20NOTES.pdf
- https://learnmech.com/computer-aided-inspection-cim-notes/
- https://canvas.instructure.com/courses/838884/pages/unit-3-lesson-6-reverse-engineering

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AUDIT COURSE-I

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M.TECH. IN CAD/CAM
COURSE STRUCTURE & SYLLABI

Course Code	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
21DAC101a		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- Understand the essentials of writing skills and their level of readability
- Learn about what to write in each section
- Ensure qualitative presentation with linguistic accuracy

Course Outcomes (CO): Student will be able to

- Understand the significance of writing skills and the level of readability
- Analyze and write title, abstract, different sections in research paper
- Develop the skills needed while writing a research paper

UNIT - I		Lecture Hrs:10

1Overview of a Research Paper- Planning and Preparation- Word Order- Useful Phrases - Breaking up Long Sentences-Structuring Paragraphs and Sentences-Being Concise and Removing Redundancy -Avoiding Ambiguity

UNIT - II		Lecture Hrs:10

Essential Components of a Research Paper- Abstracts- Building Hypothesis-Research Problem - Highlight Findings- Hedging and Criticizing, Paraphrasing and Plagiarism, Cauterization

UNIT - III		Lecture Hrs:10

Introducing Review of the Literature – Methodology - Analysis of the Data-Findings - Discussion-Conclusions-Recommendations.

UNIT - IV		Lecture Hrs:9

Key skills needed for writing a Title, Abstract, and Introduction

UNIT - V		Lecture Hrs:9

Appropriate language to formulate Methodology, incorporate Results, put forth Arguments and draw Conclusions

Suggested Reading

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) Model Curriculum of Engineering & Technology PG Courses [Volume-I]
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

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Course Code	DISASTER MANAGEMENT	L	T	P	C
21DAC101b		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- Learn to demonstrate critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluatedisasterriskreduction and humanitarian response policy and practice from
- Multiple perspectives.
- Developanunderstandingofstandardsofhumanitarianresponseandpracticalrelevanceinspecific types of disasters and conflict situations
- Criticallyunderstandthestrengthsandweaknessesofdisastermanagementapproaches,planningand programming in different countries, particularly their home country or the countries they work in

UNIT - I

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

UNIT - III

Disaster Preparedness and Management:
Preparedness: Monitoring of Phenomena Triggering ADisasteror Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT - IV

Risk Assessment Disaster Risk:
Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. TechniquesofRiskAssessment,GlobalCo-OperationinRiskAssessmentand Warning, People’s Participation in Risk Assessment. Strategies for Survival.

UNIT - V

Disaster Mitigation:
Meaning,ConceptandStrategiesofDisasterMitigation,EmergingTrendsInMitigation.Structural Mitigationand Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Suggested Reading

1. R.Nishith,SinghAK,“DisasterManagementinIndia:Perspectives,issuesandstrategies
2. “’New Royal book

Company..Sahni,PardeepEt.Al.(Eds.),"DisasterMitigationExperiencesAndReflections",PrenticeHall OfIndia, New Delhi.
3. GoelS.L.,DisasterAdministrationAndManagementTextAndCaseStudies",Deep&Deep Publication Pvt. Ltd., New Delhi

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M.TECH. IN CAD/CAM
COURSE STRUCTURE & SYLLABI

Course Code	**SANSKRITFOR TECHNICAL KNOWLEDGE**	**L**	**T**	**P**	**C**
21DAC101c		**2**	**0**	**0**	**0**
	Semester	**I**			

Course Objectives: This course will enable students:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- LearningofSanskrittodevelopthelogicinmathematics,science&othersubjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge
- Knowledge from ancientliterature

Course Outcomes (CO): Student will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science &technology can be understood
- Being a logical language will help to develop logic in students

UNIT - I

Alphabets in Sanskrit,

UNIT - II

Past/Present/Future Tense, Simple Sentences

UNIT - III

Order, Introduction of roots

UNIT - IV

Technical information about Sanskrit Literature

UNIT - V

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested Reading

1.“Abhyaspustakam” –Dr.Vishwas, Sanskrit-Bharti Publication, New Delhi
2.“Teach Yourself Sanskrit” Prathama Deeksha- VempatiKutumbshastri, RashtriyaSanskrit Sansthanam, New Delhi Publication
3.“India’s Glorious ScientificTradition” Suresh Soni, Ocean books (P) Ltd.,New Delhi

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AUDIT COURSE-II

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M.TECH. IN CAD/CAM
COURSE STRUCTURE & SYLLABI

Course Code	PEDAGOGY STUDIES	L	T	P	C
21DAC201a		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

- Reviewexistingevidenceonthereviewtopictoinformprogrammedesignandpolicy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes (CO): Student will be able to

- Students will be able to understand:
- Whatpedagogicalpracticesarebeingusedbyteachersinformalandinformalclassrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what
- conditions, and with what population of learners?
- Howcanteachereducation(curriculumandpracticum)andtheschoolcurriculumand guidance materials best support effective pedagogy?

UNIT - I

Introduction and Methodology: Aims and rationale, Policy back ground, Conceptual frame work and terminology Theories oflearning,Curriculum,Teachereducation.Conceptualframework,Research questions. Overview of methodology and Searching.

UNIT - II

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT - III

Evidence on theeffectivenessofpedagogicalpractices,Methodologyfortheindepthstage:quality assessmen t of included studies. How can teacher education (curriculumandpracticum) andthescho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of th body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT - IV

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacherandthecommunity.Curriculumandassessment,Barrierstolearning:limitedresourcesand large class sizes

UNIT - V

Researchgapsandfuturedirections:Researchdesign,Contexts,Pedagogy,Teachereducation, Curriculum and assessment, Dissemination and research impact.

Suggested Reading

1. AckersJ,HardmanF(2001)ClassroominteractioninKenyanprimaryschools,Compare, 31 (2): 245-261.
2. AgrawalM(2004)Curricularreforminschools:Theimportanceofevaluation,Journalof
3. Curriculum Studies, 36 (3): 361-379.
4. AkyeampongK(2003) Teacher training in Ghana - does it count? Multi-site teachereducation

research project (MUSTER) country report 1. London: DFID.

5. Akyeampong K, LussierK, PryorJ, Westbrook J (2013)Improving teaching and learning of basic maths and reading in Africa: Does teacherpreparation count?International Journal Educational Development, 33 (3): 272–282.
6. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
   Chavan M (2003)ReadIndia: A mass scale, rapid, ‘learning to read’campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

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M.TECH. IN CAD/CAM
COURSE STRUCTURE & SYLLABI

Course Code	STRESSMANAGEMENT BY YOGA	L	T	P	C
21DAC201b		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

- To achieve overall health of body and mind
- To overcome stres

Course Outcomes (CO): Student will be able to

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT - I

Definitions of Eight parts of yog.(Ashtanga)

UNIT - II

Yam and Niyam.

UNIT - III

Do`sand Don't'sin life.
i) Ahinsa,satya,astheya,bramhacharyaand aparigrahaii) Shaucha,santosh,tapa,swadhyay,ishwarpranidhan

UNIT - IV

Asan and Pranayam

UNIT - V

i)Variousyogposesand theirbenefitsformind &body
ii)Regularizationofbreathingtechniques and its effects-Types ofpranayam

Suggested Reading

1.'Yogic Asanas forGroupTarining-Part-I": Janardan SwamiYogabhyasiMandal, Nagpur
2."Rajayogaor conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

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M.TECH. IN CAD/CAM
COURSE STRUCTURE & SYLLABI

Course Code	PERSONALITY DEVELOPMENT THROUGHLIFE ENLIGHTENMENTSKILLS	L	T	P	C
21DAC201c		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

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

Course Outcomes (CO): Student will be able to

- StudyofShrimad-Bhagwad-Geetawillhelpthestudentindevelopinghispersonalityand achieve the highest goal in life
- The person who has studied Geetawilllead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT - I

Neetisatakam- Holistic development of personality
Verses-19,20,21,22(wisdom)
Verses-29,31,32(pride &heroism)
Verses-26,28,63,65(virtue)

UNIT - II

Neetisatakam- Holistic development of personality
Verses-52,53,59(dont's)
Verses-71,73,75,78(do's)

UNIT - III

Approach to day to day work and duties.
ShrimadBhagwadGeeta:Chapter2-Verses41,47,48,
Chapter3-Verses13,21,27,35,Chapter6-Verses5,13,17,23,35,
Chapter18-Verses45,46,48.

UNIT - IV

Statements of basic knowledge.
ShrimadBhagwadGeeta:Chapter2-Verses 56,62,68
Chapter12 -Verses13,14,15,16,17,18
Personality of Rolemodel. Shrimad Bhagwad Geeta:

UNIT - V

Chapter2-Verses 17,Chapter3-Verses36,37,42,
Chapter4-Verses18,38,39
Chapter18– Verses37,38,63

Suggested Reading

1.“SrimadBhagavadGita”bySwamiSwarupanandaAdvaitaAshram(PublicationDepartment), Kolkata
2.Bhartrihari'sThree Satakam (Niti-sringar-vairagya) by P.Gopinath, RashtriyaSanskrit Sansthanam, New Delhi.

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OPEN ELECTIVE

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M.TECH. IN CAD/CAM
COURSE STRUCTURE & SYLLABI

Course Code	BUSINESS ANALYTICS	L	T	P	C
21DOE301c		3	0	0	3
	Semester	III			

Course Objectives:

- The main objective of this course is to give the student a comprehensive understanding of business analytics methods.

Course Outcomes (CO): Student will be able to

- Students will demonstrate knowledge of data analytics.
- Students will demonstrate the ability of think critically in making decisions based on
- data and deep analytics.
- Students will demonstrate the ability to use technical skills in predicative and
- prescriptive modeling to support business decision-making.
- Students will demonstrate the ability to translate data into clear, actionable insights.

UNIT - I		Lecture Hrs:

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst.
Stakeholders: the project team, management, and the front line, Handling Stakeholder Conflicts.

UNIT - II		Lecture Hrs:

Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

UNIT - III		Lecture Hrs:

Forming Requirements: Overview of Requirements, Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents. Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

UNIT - IV		Lecture Hrs:

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements. Managing Requirements Assets: Change Control, Requirements Tools

UNIT - V		Lecture Hrs:

Recent Trands in: Embedded and colleborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

Textbooks:

1. Business Analysis by James Cadle et al.
2. Project Management: The Managerial Process by Erik Larson and, Clifford Gray

Reference Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G.
2. Schniederjans, Christopher M. Starkey, Pearson FT Press.
3. Business Analytics by James Evans, persons Education.

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COURSE STRUCTURE & SYLLABI

Course Code	INTERNET OF THINGS (IOT)	L	T	P	C
21DOE301g		3	0	0	3
	Semester	III			

Course Objectives: Student will be able

- To study fundamental concepts of IoT
- To understand roles of sensors in IoT
- To Learn different protocols used for IoT design
- To be familiar with data handling and analytics tools in IoT
- Appreciate the role of big data, cloud computing and data analytics in a typical IoT system

Course Outcomes (CO): Student will be able to

- Understand the various concepts, terminologies and architecture of IoT systems.
- Use sensors and actuators for design of IoT.
- Understand and apply various protocols for design of IoT systems
- Use various techniques of data storage and analytics in IoT
- Understand various applications of IoT
- Understand APIs to connect IoT related technologies

UNIT – I — Lecture Hrs:09

Fundamentals of IoT: Introduction, Definitions & Characteristics of IoT, IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, History of IoT, About Things in IoT, The Identifiers in IoT, About the Internet in IoT, IoT frameworks, IoT and M2M

UNIT – II — Lecture Hrs: 09

Sensors Networks : Definition, Types of Sensors, Types of Actuators, Examples and Working, IoT Development Boards: Arduino IDE and Board Types, RaspberriPi Development Kit, RFID Principles and components, Wireless Sensor Networks: History and Context, The node, Connecting nodes, Networking Nodes, WSN and IoT.

UNIT – III — Lecture Hrs: 09

Wireless Technologies for IoT: WPAN Technologies for IoT: IEEE 802.15.4, Zigbee, HART, NFC, Z-Wave, BLE, Bacnet, Modbus.
IP Based Protocols for IoT IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT. Edge connectivity and protocols

UNIT – IV — Lecture Hrs: 09

Data Handling& Analytics: Introduction, Bigdata, Types of data, Characteristics of Big data, Data handling Technologies, Flow of data, Data acquisition, Data Storage, Introduction to Hadoop. Introduction to data Analytics, Types of Data analytics, Local Analytics, Cloud analytics and applications

UNIT - V — Lecture Hrs: 09

Applications of IoT: Home Automation, Smart Cities, Energy, Retail Management, Logistics, Agriculture, Health and Lifestyle, Industrial IoT, Legal challenges, IoT design Ethics, IoT in Environmental Protection.

Textbooks:

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COURSE STRUCTURE & SYLLABI

1.Hakima Chaouchi, — "The Internet of Things Connecting Objects to the Web" ISBN : 978-1-84821-140-7, Wiley Publications 2.Olivier Hersent, David Boswarthick, and Omar Elloumi, — "The Internet of Things: Key Applications and Protocols", WileyPublications 3.Vijay Madisetti and ArshdeepBahga, — "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014. 4.J. Biron and J. Follett, "Foundational Elements of an IoT Solution", O'Reilly Media, 2016. 5.Keysight Technologies, "The Internet of Things: Enabling Technologies and Solutions for Design and Test", Application Note, 2016.
Reference Books:
1.Daniel Minoli, — "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publication 2.Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
Online Learning Resources:
https://onlinecourses.nptel.ac.in/noc17_cs22/course http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

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COURSE STRUCTURE & SYLLABI

Course Code	MECHATRONICS	L	T	P	C
21DOE301h		3	0	0	3
	Semester	III			

Course Objectives: Student will be able

- To study fundamental concepts of Signal condition
- To understand the concepts of precision mechanical systems
- To Learn different electronic interface subsystems
- To be familiar with microcontrollers overview.
- To understand the concepts of programmable logic controllers

Course Outcomes (CO): Student will be able to

- Understand the various concepts, terminologies of Signal condition
- Understand the basics electronic interface subsystems
- Understand and apply various precision mechanical systems
- Understand various applications of microcontrollers overview
- Understand the controlling of programmable logic and programmable motion.

UNIT – I Lecture Hrs:09

INTRODUCTION : Definition – Trends - Control Methods: Standalone , PC Based (Real Time Operating Systems, Graphical User Interface , Simulation) - Applications: SPM, Robot, CNC, FMS, CIM.
SIGNAL CONDITIONING : Introduction – Hardware - Digital I/O, Analog input – ADC, resolution , speed channels Filtering Noise using passive components – Resistors, capacitors - Amplifying signals using OP amps – Software - Digital Signal Processing – Low pass , high pass , notch filtering.

UNIT – II Lecture Hrs: 09

PRECISION MECHANICAL SYSTEMS : Pneumatic Actuation Systems - Electro-pneumatic Actuation Systems - Hydraulic Actuation Systems - Electro-hydraulic Actuation Systems - Timing Belts – Ball Screw and Nut - Linear Motion Guides - Linear Bearings - Harmonic Transmission - Bearings- Motor / Drive Selection.

UNIT – III Lecture Hrs: 09

ELECTRONIC INTERFACE SUBSYSTEMS : TTL, CMOS interfacing - Sensor interfacing – Actuator interfacing – solenoids , motors Isoation schemes- opto coupling, buffer IC's - Protection schemes – circuit breakers , over current sensing , resetable fuses , thermal dissipation - Power Supply - Bipolar transistors / mosfets
ELECTROMECHANICAL DRIVES : Relays and Solenoids - Stepper Motors - DC brushed motors – DC brushless motors - DC servo motors - 4-quadrant servo drives , PWM's - Pulse Width Modulation – Variable Frequency Drives, Vector Drives - Drive System load calculation

UNIT – IV Lecture Hrs: 09

MICROCONTROLLERS OVERVIEW: 8051 Microcontroller , micro processor structure - DigitalInterfacing - Analog Interfacing - Digital to Analog Convertors - Analog to Digital Convertors - Applications. Programming –Assembly , C (LED Blinking , Voltage measurement using ADC).

UNIT - V Lecture Hrs: 09

PROGRAMMABLE LOGIC CONTROLLERS : Basic Structure - Programming : Ladder diagram - Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls - Data Handling -

Analog input / output - PLC Selection - Application. PROGRAMMABLE MOTION CONTROLLERS : Introduction - System Transfer Function – Laplace transform and its application in analysing differential equation of a control system - Feedback Devices :Position , Velocity Sensors - Optical Incremental encoders - Proximity Sensors : Inductive , Capacitive ,
Textbooks:
1. A text book of Mechatronics by Er.R.K. RAJPUT ., S.CHAND publications 2. A text book of Mechatronics by Nitalgour Premchand Mahalik ., McGraw Hill publications
Reference Books:
1. A text book of Mechatronics by W.Bolton ., Pearson Publications

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COURSE STRUCTURE & SYLLABI

SEMESTER – I

S. No.	Course codes	Course Name	Category	Hours per			Credits
				L	T	P	
1.	21D38101	Advanced Digital System Design	PC	3	0	0	3
2.	21D38102	Wireless Communication and Networks	PC	3	0	0	3
3.	21D38103a 21D06202 21D06203a	**Program Elective – 1** Design of Fault Tolerant Systems VLSI Technology and Design SoC Architecture	PE	3	0	0	3
4.	21D38104a 21D38104b 21D38104c	**Program Elective – 1** Coding Theory and Techniques Optical Communication and Networks 5G Communications	PE	3	0	0	3
5.	21D38105	Advanced Digital System Design Lab	PC	0	0	4	2
6.	21D38106	Wireless Communication and Networks Lab	PC	0	0	4	2
7.	21DRM101	Research Methodology and IPR	MC	2	0	0	2
8.	21DAC101a 21DAC101b 21DAC101c	**Audit Course – I** English for Research paper writing Disaster Management Sanskrit for Technical Knowledge	AC	2	0	0	0
Total							**18**

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SEMESTER – II

S.No.	Course codes	Course Name	Category	Hours per week L	T	P	Credits
1.	21D38201	Network Security and Cryptography	PC	3	0	0	3
2.	21D38202	Advanced Communications and Networks	PC	3	0	0	3
3.	21D06201 21D06203c 21D06301a	**Program Elective – III** Embedded System Design Embedded Real Time Operating Systems Embedded Systems Protocols	PE	3	0	0	3
4.	21D38203a 21D38203b 21D06204b	**Program Elective – IV** Cognitive Radio Image and Video Processing Adhoc and Wireless Sensor Networks	PE	3	0	0	3
5.	21D38204	Network Security and Cryptography Lab	PC	0	0	4	2
6.	21D38205	Advanced Communications and Networks Lab	PC	0	0	4	2
7.	21D38206	Technical seminar	PR	0	0	4	2
8.	21DAC201a 21DAC201b 21DAC201c	**Audit Course – II** Pedagogy Studies Stress Management for Yoga Personality Development through Life Enlightenment Skills	AC	2	0	0	0
		Total					**18**

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SEMSTER - III

S.No.	Course codes	Course Name	Category	Hours per			Credits
				L	T	P	
1.	 21D38301a 21D57204b 21D38301b	**Program Elective – V** Voice and Data Networks IoT and Its Applications Artificial Intelligence and Machine Learning	PE	3	0	0	3
2.	 21DOE301b 21DOE301c 21DOE301e	**Open Elective** Industrial Safety Business Analytics Waste to Energy	OE	3	0	0	3
3.	21D38302	Dissertation Phase – I	PR	0	0	20	10
4.	21D38303	Co-curricular Activities					2
		Total					**18**

SEMESTER - IV

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D38401	Dissertation Phase – II	PR	0	0	32	16
		Total					**16**

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COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED DIGITAL SYSTEM DESIGN	L	T	P	C
21D38101		3	0	0	3
	Semester	I			

Course Objectives:

- To understand an overview of system design approach using programmable logic devices.
- To implement combinational logic circuit design.
- To implement sequential logic circuit design.
- To learn software tools used for design process with the help of case studies.

Course Outcomes (CO): Student will be able to

- Understand an overview of system design approach using programmable logic devices.
- Implement combinational logic circuit design.
- Implement sequential logic circuit design.
- Learn software tools used for design process with the help of case studies.

UNIT - I — Lecture Hrs:

Processor Arithmetic: Two's Complement Number System - Arithmetic Operations; Fixed point Number System; Floating Point Number system - IEEE 754 format, Basic binary codes.

UNIT - II — Lecture Hrs:

Combinational circuits: CMOS logic design, Static and dynamic analysis of Combinational circuits, timing hazards. Functional blocks: Decoders, Encoders, Three-state devices, Multiplexers, Parity circuits, Comparators, Adders, Subtractors, Carry look-ahead adder – timing analysis. Combinational multiplier structures.

UNIT - III — Lecture Hrs:

Sequential Logic - Latches and Flip-Flops, Sequential logic circuits - timing analysis (Set up and hold times), State machines - Mealy & Moore machines, Analysis, FSM design using D Flip-Flops, FSM optimization and partitioning; Synchronizers and metastability. FSM Design examples: Vending machine, Traffic light controller, Washing machine.

UNIT - IV — Lecture Hrs:

Subsystem Design using Functional Blocks (1) - Design (including Timing Analysis) of different logical blocks of varying complexities involving mostly combinational circuits:

- ALU
- 4-bit combinational multiplier
- Barrel shifter
- Simple fixed point to floating point encoder
- Dual Priority encoder
- Cascading comparators

UNIT - V — Lecture Hrs:

Subsystem Design using Functional Blocks (2) - Design, (including Timing Analysis) of different logical blocks of different complexities involving mostly sequential circuits:

- Pattern (sequence) detector
- Programmable Up-down counter
- Round robin arbiter with 3 requesters
- Process Controller
- FIFO

Textbooks:

1. M. Morris Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog", Pearson Education; 6th Edition, 2018
2. John F. Wakerly, "Digital Design", Prentice Hall, 3rd Edition, 2002.

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COURSE STRUCTURE & SYLLABI

Course Code	WIRELESS COMMUNICATIONS AND NETWORKS	L	T	P	C
21D38102		3	0	0	3
	Semester	I			

Course Objectives:

- To study the Channel planning for Wireless Systems
- To study the Mobile Radio Propagation
- To study the Equalization and Diversity
- To study the Wireless Networks

Course Outcomes (CO):

- Understand Cellular communication concepts
- Study the mobile radio propagation
- Study the wireless network different type of MAC protocols

UNIT - I Lecture Hrs:

The Cellular Concept-System Design Fundamentals: Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies- Prioritizing Handoffs, Practical Handoff Considerations, Interference and system capacity – Co channel Interference and system capacity, Channel planning for Wireless Systems, Adjacent Channel interference, Power Control for Reducing interference, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems- Cell Splitting, Sectoring.

UNIT - II Lecture Hrs:

Mobile Radio Propagation: Large-Scale Path Loss: Introduction to Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, The Three Basic Propagation Mechanisms, Reflection-Reflection from Dielectrics, Brewster Angle, Reflection from prefect conductors, Ground Reflection (Two-Ray) Model, Diffraction-Fresnel Zone Geometry, Knife-edge Diffraction Model, Multiple knife-edge Diffraction, Scattering, Outdoor Propagation Models- Longley-Ryce Model, Okumura Model, Hata Model, PCS Extension to Hata Model, Walfisch and Bertoni Model, Wideband PCS Microcell Model, Indoor Propagation Models-Partition losses (Same Floor), Partition losses between Floors, Log-distance path loss model, Ericsson Multiple Breakpoint Model, Attenuation Factor Model, Signal penetration into buildings, Ray Tracing and Site Specific Modeling.

UNIT - III Lecture Hrs:

Mobile Radio Propagation: Small –Scale Fading and Multipath: Small Scale Multipath propagationFactors influencing small scale fading, Doppler shift, Impulse Response Model of a multipath channelRelationship between Bandwidth and Received power, Small-Scale Multipath Measurements-Direct RF Pulse System, Spread Spectrum Sliding Correlator Channel Sounding, Frequency Domain Channels Sounding, Parameters of Mobile Multipath Channels-Time Dispersion Parameters, Coherence Bandwidth, Doppler Spread and Coherence Time, Types of Small-Scale Fading-Fading effects Due to Multipath Time Delay Spread, Flat fading, Frequency selective fading, Fading effects Due to Doppler Spread-Fast fading, slow fading, Statistical Models for multipath Fading ChannelsClarke's model for flat fading, spectral shape due to Doppler spread in Clarke's model, Simulation of Clarke and Gans Fading Model, Level crossing and fading statistics, Two-ray Rayleigh Fading Model.

UNIT - IV Lecture Hrs:

Equalization and Diversity: Introduction, Fundamentals of Equalization, Training A Generic Adaptive Equalizer, Equalizers in a communication Receiver, Linear Equalizers, Non-linear Equalization-Decision Feedback Equalization (DFE), Maximum Likelihood Sequence Estimation

(MLSE) Equalizer, Algorithms for adaptive equalization-Zero Forcing Algorithm, Least Mean Square Algorithm, Recursive least squares algorithm. Diversity Techniques-Derivation of selection Diversity improvement, Derivation of Maximal Ratio Combining improvement, Practical Space Diversity Consideration-Selection Diversity, Feedback or Scanning Diversity, Maximal Ratio Combining, Equal Gain Combining, Polarization Diversity, Frequency Diversity, Time Diversity, RAKE Receiver.		
UNIT - V		Lecture Hrs:
Wireless Networks: Introduction to wireless Networks, Advantages and disadvantages of Wireless Local Area Networks, WLAN Topologies, WLAN Standard IEEE 802.11, IEEE 802.11 Medium Access Control, Comparison of IEEE 802.11 a,b,g and n standards, IEEE 802.16 and its enhancements, Wireless PANs, Hiper Lan, WLL.		
Textbooks:		
1. Wireless Communications, Principles, Practice – Theodore, S. Rappaport, 2nd Ed., 2002, PHI. 2. Wireless Communications-Andrea Goldsmith, 2005 Cambridge University Press. 3. Principles of Wireless Networks – KavehPahLaven and P. Krishna Murthy, 2002, PE 4. Mobile Cellular Communication – GottapuSasibhushana Rao, Pearson Education, 2012.		
Reference Books:		
1. Wireless Digital Communications – KamiloFeher, 1999, PHI. 2. Wireless Communication and Networking – William Stallings, 2003, PHI		

M.TECH. IN DIGITAL ELECTRONICS & COMMUNICATION SYSTEMS

COURSE STRUCTURE & SYLLABI

Course Code	DESIGN OF FAULT TOLERANT SYSTEMS	L	T	P	C
21D38103a		3	0	0	3
	Semester	I			

Course Objectives:

- To provide broad understanding of fault diagnosis and tolerant design approach.
- To illustrate the framework of test pattern generation using semi and full automatic approach.
- To acquire the knowledge of scan architectures.
- To acquire the knowledge of design of built-in-self test.

Course Outcomes (CO): Student will be able to

- Provide broad understanding of fault diagnosis and tolerant design approach.
- Illustrate the framework of test pattern generation using semi and full automatic approach.
- Acquire the knowledge of scan architectures.
- Acquire the knowledge of design of built-in-self test.

UNIT - I Lecture Hrs:

Fault Tolerant Design

Basic concepts: Reliability concepts, Failures & faults, Reliability and Failure rate, Relation between reliability and mean time between failure, maintainability and availability, reliability of series, parallel and parallel-series combinational circuits.

Fault Tolerant Design

Basic concepts-static, dynamic, hybrid, triple modular redundant system (TMR), 5MR reconfiguration techniques, Data redundancy, Time redundancy and software Redundancy concepts.

UNIT - II Lecture Hrs:

Self Checking circuits & Fail safe Design

Basic concepts of self checking circuits, Design of Totally self checking checker, Checkers using m out of n codes, Berger code, Low cost residue code.

Fail Safe Design- Strongly fault secure circuits, fail safe design of sequential circuits using partition theory and Berger code, totally self checking PLA design

UNIT - III Lecture Hrs:

Design for Testability

Design for testability for combinational circuits: Basic concepts of Testability, Controllability and observability, The Reed Muller's expansion technique, use of control and syndrome testable designs.

Design for testability by means of scan

Making circuits Testable, Testability Insertion, Full scan DFT technique- Full scan insertion, flip-flop Structures, Full scan design and Test, Scan Architectures-full scan design, Shadow register DFT, Partial scan methods, multiple scan design, other scan designs.

UNIT - IV Lecture Hrs:

Logic Built-in-self-test

BIST Basics-Memory-based BIST,BIST effectiveness, BIST types, Designing a BIST, Test Pattern Generation-Engaging TPGs, exhaustive counters, ring counters, twisted ring counter, Linear feedback shift register, Output Response Analysis-Engaging ORA's, One's counter, transition counter, parity checking, Serial LFSRs, Parallel Signature analysis, BIST architectures-BIST related terminologies, A centralised and separate Board-level BIST architecture, Built-in evaluation and self test(BEST), Random Test socket(RTS), LSSD On-chip self test, Self –testing using MISR and SRSG, Concurrent BIST, BILBO, Enhancing coverage, RT level BIST design-CUT design, simulation and synthesis, RTS BIST insertion, Configuring the RTS BIST, incorporating

configurations in BIST, Design of STUMPS, RTS and STUMPS results.		
UNIT - V		Lecture Hrs:
Standard IEEE Test Access Methods Boundary Scan Basics, Boundary scan architecture- Test access port, Boundary scan registers, TAP controller, the decoder unit, select and other units, Boundary scan Test Instructions-Mandatory instructions, Board level scan chain structure-One serial scan chain, multiple-scan chain with one control test port, multiple-scan chains with one TDI,TDO but multiple TMS, Multiple-scan chain, multiple access port, RT Level boundary scan-inserting boundary scan test hardware for CUT, Two module test case, virtual boundary scan tester, Boundary Scan Description language.		
Textbooks:		
1. Fault Tolerant & Fault Testable Hardware Design- Parag K.Lala,PHI, 1984. 2. Digital System Test and Testable Design using HDL models and Architectures - ZainalabedinNavabi, Springer International Ed.,		
Reference Books:		
1. Digital Systems Testing and Testable Design-MironAbramovici, Melvin A.Breuer and Arthur D. Friedman, Jaico Books 2. Essentials of Electronic Testing- Bushnell &VishwaniD.Agarwal,Springers. 3. Design for Test for Digital IC's and Embedded Core Systems- Alfred L. Crouch, 2008		

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M.TECH. IN DIGITAL ELECTRONICS & COMMUNICATION SYSTEMS

COURSE STRUCTURE & SYLLABI

Course Code	VLSI TECHNOLOGY AND DESIGN	L	T	P	C
21D06202		3	0	0	3
	Semester	II			

Course Objectives:

- To familiarize with large scale integration technology.
- To expose fabrication methods, layout and design rules.
- To learn methods to improve Digital VLSI system’s performance.
- To know about VLSI Design constraints.

Course Outcomes (CO):

- Familiarize with large scale integration technology.
- Expose fabrication methods, layout and design rules.
- Learn methods to improve Digital VLSI system’s performance.
- Know about VLSI Design constraints.

UNIT - I		Lecture Hrs:

Review of Microelectronics and Introduction to MOS Technologies-
MOS, CMOS, BiCMOS Technology. Basic Electrical Properties of MOS, CMOS &BiCMOS Circuits: Ids – Vds relationships, Threshold Voltage V_T, g_m, g_{ds} and ω_o, Pass Transistor, MOS, CMOS & Bi CMOS Inverters, Zpu/Zpd, MOS Transistor circuit model, Latch-up in CMOS circuits.

UNIT - II		Lecture Hrs:

Layout Design and Tools
Transistor structures, Wires and Vias, Scalable Design rules, Layout Design tools.
Logic Gates & Layouts
Static Complementary Gates, Switch Logic, Alternative Gate circuits, Low power gates, Resistive and Inductive interconnect delays.

UNIT - III		Lecture Hrs:

Combinational Logic Networks
Layouts, Simulation, Network delay, Interconnect design, Power optimization, Switch logic networks, Gate and Network testing.

UNIT - IV		Lecture Hrs:

Sequential Systems
Memory cells and Arrays, Clocking disciplines, Design, Power optimization, Design validation and testing.

UNIT - V		Lecture Hrs:

Floor Planning
Floor planning methods, Global Interconnect, Floor Plan Design, Off-chip connections.

Textbooks:

1. Neil Weste, David Harris, “CMOS VLSI Design: A Circuits and Systems Perspective”, 4^{th} Edition, Pearson, 2010
2. Essentials of VLSI Circuits and Systems, K. EshraghianEshraghian. D, A. Pucknell, 2005, PHI.
3. Modern VLSI Design – Wayne Wolf, 3rd Ed., 1997, Pearson Education.

Reference Books:

1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press, 2011.
2. Principals of CMOS VLSI Design – N.H.E Weste, K. Eshraghian, 2nd Ed., Addison Wesley.

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M.TECH. IN DIGITAL ELECTRONICS & COMMUNICATION SYSTEMS

COURSE STRUCTURE & SYLLABI

Course Code	SoC ARCHITECTURE	L	T	P	C
21D06203a		3	0	0	3
	Semester	III			

Course Objectives:

- To understand the basics related to SoC architecture and different approaches related to SoC Design.
- To select an appropriate robust processor for SoC Design
- To select an appropriate memory for SoC Design.
- To realize real time case studies

Course Outcomes (CO): Student will be able to

- Understand the basics related to SoC architecture and different approaches related to SoC Design.
- Select an appropriated robust processor for SoC Design
- Select an appropriate memory for SoC Design.
- Realize real time case studies

UNIT - I Lecture Hrs:

Introduction to the System Approach: 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 Lecture Hrs:

Processors: 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 Lecture Hrs:

Memory Design for SOC: 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 Lecture Hrs:

Interconnect, Customization and Configurability: 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 Lecture Hrs:

Application Studies / Case Studies: SOC Design approach; AES-algorithms, Design and evaluation; Image compression–JPEG compression.

Textbooks:

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

Reference Books:

1. Design of System on a Chip: Devices and Components – Ricardo Reis, 1st Ed., 2004, Springer

2.Co-Verification of Hardware and Software for ARM System on Chip Design (EmbeddedTechnology) – Jason Andrews – Newnes, BK and CDROM. 3.System on Chip Verification – Methodologies and Techniques –PrakashRashinkar, PeterPaterson and Leena Singh L, 2001, Kluwer Academic Publishers

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M.TECH. IN DIGITAL ELECTRONICS & COMMUNICATION SYSTEMS

COURSE STRUCTURE & SYLLABI

Course Code	CODING THEORY AND TECHNIQUES	L	T	P	C
21D38104a		3	0	0	3
	Semester	I			

Course Objectives:
- To learn the measurement of information and errors.
- To obtain knowledge in designing Linear Block Codes and Cyclic codes.
- To construct tree and trellies diagrams for convolution codes
- To design the Turbo codes and Space time codes and also their applications

Course Outcomes (CO):
- Learning the measurement of information and errors.
- Obtain knowledge in designing Linear Block Codes and Cyclic codes.
- Construct tree and trellies diagrams for convolution codes
- Design the Turbo codes and Space time codes and also their applications

UNIT - I Lecture Hrs:

Coding for Reliable Digital Transmission and storage: Mathematical model of Information, Alogarithmic Measure of Information, Average and Mutual Information and Entropy, Types of Errors, Error Control Strategies.

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

UNIT - II Lecture Hrs:

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

UNIT - III Lecture Hrs:

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

UNIT - IV Lecture Hrs:

Turbo Codes: LDPC Codes- Codes based on sparse graphs, Decoding for binary erasure channel, Log-likelihood algebra, Brief propagation, Product codes, Iterative decoding of product codes, Concatenated convolutional codes- Parallel concatenation, The UMTS Turbo code, Serial concatenation, Parallel concatenation, Turbo decoding

UNIT - V Lecture Hrs:

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

Linear Dispersion Codes.
Textbooks:
1. Error Control Coding- Fundamentals and Applications –Shu Lin, Daniel J. Costello, Jr, Prentice Hall, Inc. 2. Error Correcting Coding Theory-Man Young Rhee, McGraw-Hill, 1989.
Reference Books:
1. Digital Communications-Fundamental and Application - Bernard Sklar, PE. 2. Digital Communications- John G. Proakis, 5th ed. TMH, 2008. 3. Error Correction Coding – Mathematical Methods and Algorithms – Todd K. Moon, Wiley India, 2006. 4. Information Theory, Coding and Cryptography – Ranjan Bose, 2nd Edition, TMH, 2009

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M.TECH. IN DIGITAL ELECTRONICS & COMMUNICATION SYSTEMS

COURSE STRUCTURE & SYLLABI

Course Code	OPTICAL COMMUNICATIONS AND NETWORKS	L	T	P	C
21D38104b		3	0	0	3
	Semester	I			

Course Objectives:

- To understand the concept and structures of optical fibers.
- To study about the photo sources and detectors in digital and analog domains.
- To learn various network topologies and protocols
- To study about performance measurement and monitoring of optical communication systems.

Course Outcomes (CO):

- Understand the concept and structures of optical fibers.
- Study about the photo sources and detectors in digital and analog domains.
- Learn various network topologies and protocols
- Study about performance measurement and monitoring of optical communication systems.

UNIT - I — Lecture Hrs:

Optical Fibers: Structures, waveguiding and Fabrication: Nature of Light, Basic optical laws and definitions, Single mode fibers, Graded index fiber structure, Attenuation, Signal Dispersion in fibers.
Optical Sources- LEDs, Laser Diodes, Line Coding.

UNIT - II — Lecture Hrs:

Photo detectors: Photo detector Noise, Detector Response Time, Avalanche Multiplication Noise.
Optical Receiver Operation: Fundamental receiver operation, Digital receiver performance, Eye diagrams.
WDM Concepts and Components: Passive optical Couplers, Isolators and Circulators

UNIT - III — Lecture Hrs:

Digital Links: Point to point links, power penalties, error control, Coherent detection, Differential Quadrature Phase Shift Keying.
Analog Links: Carrier to noise ration, Multichannel Transmission Techniques, RF over Fiber, Radio over fiber links, Microwave Photonics.

UNIT - IV — Lecture Hrs:

Optical Networks: Network Concepts, Network Topologies, SONET/SDH, High speed lightwave links, Optical add/ Drop Multiplexing, Optical Switching, WDM Network, Passive Optical Networks, IP Over DWDM, Optical Ethernet, Mitigation of Transmission Impairments

UNIT - V — Lecture Hrs:

Performance Measurement and Monitoring: Measurement standards, Basic Test Equipment, Optical power measurement, Optical fiber characterization, Eye diagram tests, optical time domain reflectometer, optical performance monitoring, optical fiber system performance measurements.

Textbooks:

1. Gerd Keiser, “Optical Fiber Communications”, 5th Edition, Mc Graw Hill.
2. Rajeev Ramaswamy and Kumar N Sivarajan, “Optical Networks: A Practical Perspective”, 2nd Ed., 2004, Elsevier Morgan Kaufmann Publishers (An imprint of Elsevier).

Reference Books:

1. John. M. Senior, “Optical Fiber Communications: Principles and Practice”, 2nd Ed, 2000, PE.
2. Harold Kolimbris, “Fiber Optic Communication”, 2nd Ed, 2004, PEI
3. Uyless Black, “Optical Networks: Third Generation Transport Systems”, 2nd Ed, 2009, PEI
4. Govind Agarwal, “Optical Fiber Communications”, 2nd Ed, 2004, TMH.
5. S. C. Gupta, “Optical Fiber Communications and its Applications”, 2004, PH

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M.TECH. IN DIGITAL ELECTRONICS & COMMUNICATION SYSTEMS

COURSE STRUCTURE & SYLLABI

Course Code	5G COMMUNICATIONS	L	T	P	C
21D38104c		3	0	0	3
	Semester	I			

Course Objectives:

- To understand 5G Technology advances and their benefits
- To learn the key RF, PHY, MAC and air interface changes required to support 5G
- To acquire knowledge on Device to device communication and millimeter wave communication
- To explore implementation options for 5G

Course Outcomes (CO):

- Understand 5G Technology advances and their benefits
- Learn the key RF, PHY, MAC and air interface changes required to support 5G
- Acquire knowledge on Device to device communication and millimeter wave communication
- Explore implementation options for 5G

UNIT - I | Lecture Hrs:

Overview of 5G Broadband Wireless Communications:
Evolution of mobile technologies 1G to 4G (LTE, LTEA, LTEA Pro) , An Overview of 5G requirements, Regulations for 5G,Spectrum Analysis and Sharing for 5G.

UNIT - II | Lecture Hrs:

The 5G wireless Propagation Channels:
Channel modeling requirements, propagation scenarios and challenges in the 5G modeling, Channel Models for mmWave MIMO Systems.

UNIT - III | Lecture Hrs:

Transmission and Design Techniques for 5G:
Basic requirements of transmission over 5G, Modulation Techniques – Orthogonal frequency division multiplexing (OFDM), generalized frequency division multiplexing (GFDM), filter bank multi-carriers (FBMC) and universal filtered multi-carrier (UFMC), Multiple Accesses Techniques – orthogonal frequency division multiple accesses (OFDMA), generalized frequency division multiple accesses (GFDMA), nonorthogonal multiple accesses (NOMA).

UNIT - IV | Lecture Hrs:

Device-to-Device (D2D) and Machine-to-Machine (M2M) type Communications
Extension of 4G D2D standardization to 5G, radio resource management for mobile broadband D2D, multihop and multi-operator D2D communications.

UNIT - V | Lecture Hrs:

Millimeter-wave Communications
Spectrum regulations, deployment scenarios, beamforming, physical layer techniques, interference and mobility management, Massive MIMO propagation channel models, Channel Estimation in Massive MIMO, Massive MIMO with Imperfect CSI, Multi-Cell Massive MIMO, Pilot Contamination, Spatial Modulation (SM).

Textbooks:

1. Martin Sauter "From GSM From GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband", Wiley-Blackwell.
2. AfifOsseiran, Jose.F.Monserrat, Patrick Marsch, "Fundamentals of 5G Mobile Networks" , Cambridge University Press.
3. Athanasios G.Kanatos, Konstantina S.Nikita, Panagiotis Mathiopoulos, "New Directions in

Wireless Communication Systems from Mobile to 5G", CRC Press. 4. Theodore S.Rappaport, Robert W.Heath, Robert C.Danials, James N.Murdock "Millimeter Wave Wireless Communications", Prentice Hall Communications.
Reference Books:
1. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", John Wiley & Sons. 2. Amitabha Ghosh and RapeepatRatasuk "Essentials of LTE and LTE-A", Cambridge University Pres

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M.TECH. IN DIGITAL ELECTRONICS & COMMUNICATION SYSTEMS

COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED DIGITAL SYSTEM DESIGN LAB	L	T	P	C
21D38105		0	0	4	2
	Semester	I			

Course Objectives:

- To familiarize the HDL simulator / synthesis tool
- To design and implement given combinational circuit on FPGA device
- To design and implement given sequential circuit on FPGA device

Course Outcomes (CO):

- Familiarize the HDL simulator / synthesis tool
- Design and implement given combinational circuit on FPGA device
- Design and implement given sequential circuit on FPGA device

List of Experiments:

Student has to design ANY TWELVE experiments of his/her user defined library components by using and standard HDL simulator / Synthesis tool for target FPGA device.

1. HDL code to realize all the logic gates
2. Design and Simulation of adder, Serial Binary Adder, Multi Precession Adder, Carry
3. Look Ahead Adder.
4. Design of 2-to-4 decoder
5. Design of 8-to-3 encoder (without and with parity)
6. Design of 8-to-1 multiplexer
7. Design of 4 bit binary to gray converter
8. Design of Multiplexer/ Demultiplexer, comparator
9. Design of Full adder using 3 modeling styles
10. Design of flip flops: SR, D, JK, T
11. Design of 4-bit binary, BCD counters (synchronous/ asynchronous reset) or any sequence counter
12. Design of a N- bit Register of Serial- in Serial –out, Serial in parallel out, Parallel in
13. Serial out and Parallel in Parallel Out.
14. Design of Sequence Detector (Finite State Machine- Mealy and Moore Machines).
15. Design of 4- Bit Multiplier, Divider.
16. Design of ALU to Perform – ADD, SUB, AND-OR, 1's and 2's Compliment,
17. Multiplication, and Division.
18. Design of Finite State Machine.
19. Implementing the above designs on Xilinx/Altera/Cypress/equivalent based FPGA/CPLD kits.

Software Requirements:

Xilinx Vivado / Int

Hardware Requirements:

Course Code	WIRELESS COMMUNICATIONS AND NETWORKS LAB	L	T	P	C
21D38106		0	0	4	2
	Semester	I			

Course Objectives:

- To understand concepts of GSM/CDMA technologies
- To implement signal processing algorithms for the given specifications
- To implement wireless communication algorithms for the given specifications

Course Outcomes (CO):

- Understand concepts of GSM/CDMA technologies
- Implement signal processing algorithms for the given specifications
- Implement wireless communication algorithms for the given specifications

List of Experiments:

Student has to design ANY TWELVE experiments of his/her user defined library components by using and standard HDL simulator / Synthesis tool for target FPGA device.

1. Implementation of Convolutional Encoder and Decoder.
2. Simulation of the following Outdoor Path loss propagation models using MATLAB.
a. Free Space Propagation model
b. Okumura model
c. Hata model
3. Simulation of Adaptive Linear Equalizer using MAT LAB software.
4. Measurement of call blocking probability for GSM &CDMA networks using Netsim software.
5. Study of GSM handset for various signalling and fault insertion techniques (Major GSM handset sections: clock, SIM card, charging, LCD module, Keyboard, User interface).
6. Study of transmitter and receiver section in mobile handset and measure frequency
7. band signal and GMSK modulating signal.
8. Simulation of RAKE Receiver for CDMA communication using MAT LAB software.
9. Simulate and test various types of PN codes, chip rate, spreading factor and processing gain on performance of DSSS in CDMA.
10. Simulate and test the 3G Network system features using GSM AT Commands. (Features of 3G Communication system: Transmission of voice, video calls, SMS, MMS,TCP/IP,HTTP,GPS)
11. Modelling of communication system using Simulink.

Software Requirements:
MATLAB, NetSim

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M.TECH. IN DIGITAL ELECTRONICS & COMMUNICATION SYSTEMS

COURSE STRUCTURE & SYLLABI

Course Code	RESEARCH METHODOLOGY AND IPR	L	T	P	C
21DRM101		2	0	0	2
	Semester	I			

Course Objectives:

- Identify an appropriate research problem in their interesting domain.
- Understand ethical issues understand the Preparation of a research project thesis report.
- Understand the Preparation of a research project thesis report
- Understand the law of patent and copyrights.
- Understand the Adequate knowledge on IPR

Course Outcomes (CO): Student will be able to

- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT - I Lecture Hrs:

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, scope, and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT - II Lecture Hrs:

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT - III Lecture Hrs:

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT - IV Lecture Hrs:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT - V

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Textbooks:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

Reference Books:

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.

5. Asimov, "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.

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M.TECH. IN DIGITAL ELECTRONICS & COMMUNICATION SYSTEMS

COURSE STRUCTURE & SYLLABI

Course Code	NETWORK SECURITY AND CRYPTOGRAPHY	L	T	P	C
21D38201		3	0	0	3
Semester		I			

Course Objectives:

- To identify and utilize different forms of cryptography techniques.
- To incorporate authentication and security in the network applications.
- To distinguish among different types of threats to the system and handle the same.

Course Outcomes (CO):

- Identify and utilize different forms of cryptography techniques.
- Incorporate authentication and security in the network applications.
- Distinguish among different types of threats to the system and handle the same.

UNIT - I Lecture Hrs:

Security: 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 Lecture Hrs:

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

UNIT - III Lecture Hrs:

Private-Key (Symmetric) Cryptography: 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 Lecture Hrs:

Public-Key (Asymmetric) Cryptography: 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 Lecture Hrs:

Authentication and System Security: 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.

Textbooks:

1. William Stallings, "Cryptography and Network Security, Principles and Practices", Pearson Education, 3rd Edition.
2. Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security, Private Communication in a Public World", Prentice Hall, 2ND Edition.

Reference Books:

1. Christopher M. King, ErtemOsmanoglu, Curtis Dalton, "Security Architecture, Design Deployment and Operations", RSA Pres,

2. Stephen Northcutt, LenyZeltser, Scott Winters, Karen Kent, and Ronald W. Ritchey, “Inside Network Perimeter Security”, Pearson Education, 2 ndEdition
3. Richard Bejtlich, “The Practice of Network Security Monitoring: Understanding Incident Detection and Response”, William Pollock Publisher, 2013.

M.TECH. IN DIGITAL ELECTRONICS & COMMUNICATION SYSTEMS

COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED COMMUNICATIONS AND NETWORKS	L	T	P	C
21D38202		3	0	0	3
	Semester	II			

Course Objectives:

- To understand about various spread spectrum communication techniques.
- To understand about different aspects related to OFDM.
- To learn about concepts of MIMO systems
- To understand various protocols used in wireless networks

Course Outcomes (CO):

Student will be able to

- Understand about various spread spectrum communication techniques.
- Understand about different aspects related to OFDM.
- Learn about concepts of MIMO systems
- Understand various protocols used in wireless networks

UNIT - I		Lecture Hrs:

Spread Spectrum Communications: Spreading sequences- Properties of Spreading Sequences, Pseudo- noise sequence, Gold sequences, Kasami sequences, Walsh Sequences, Orthogonal Variable Spreading Factor Sequences, Barker Sequence, Complementary Codes

Direct sequence spread spectrum: DS-CDMA Model, Conventional receiver, Rake Receiver, Synchronization in CDMA, Power Control, Soft handoff, Multiuser detection – Optimum multiuser detector, Liner multiuser detection.

UNIT - II		Lecture Hrs:

Orthogonal Frequency Division Multiplexing: Basic Principles of Orthogonality, Single vs Multicarrier Systems, OFDM Block Diagram and Its Explanation, OFDM Signal Mathematical Representation, Selection parameter for Modulation, Pulse shaping in OFDM Signal and Spectral Efficiency, Window in OFDM Signal and Spectrum, Synchronization in OFDM, Pilot Insert in OFDM Transmission and Channel Estimation, Amplitude Limitations in OFDM, FFT Point Selection Constraints in OFDM, CDMA vs OFDM, Hybrid OFDM.

UNIT - III		Lecture Hrs:

MIMO Systems: Introduction, Space Diversity and System Based on Space Diversity, Smart Antenna system and MIMO, MIMO Based System Architecture, MIMO Exploits Multipath, Space – Time Processing, Antenna Consideration for MIMO, MIMO Channel Modelling, MIMO Channel Measurement, MIMO Channel Capacity, Cyclic Delay Diversity (CDD), Space Time Coding, Advantages and Applications of MIMO in Present Context, MIMO Applications in 3G Wireless System and Beyond, MIMO-OFDM

UNIT - IV		Lecture Hrs:

Wireless LANs/IEEE 802.11x: Introduction to IEEE802.11x Technologies, Evolution of wireless LANs, IEEE 802.11 Design Issues, IEEE 802.11 Services, IEEE 802.11 MAC Layer operations, IEEE 802.11 Layer1, IEEE 802.11 a/b/g Higher Rate Standards, Wireless LAN Security, Computing Wireless Technologies, Typical WLAN Hardware

UNIT - V		Lecture Hrs:

Wireless PANs/IEEE 802.15x: Introduction to IEEE 802.15x Technologies: Wireless PAN Applications and Architecture, IEEE 802.15.1 Physical Layer Details, Bluetooth Link Controllers Basics, Bluetooth Link Controllers Operational States, IEEE 802.15.1 Protocols and Host Control Interface. Evaluation of IEEE 802.15 Standards

Broad Band Wireless MANs/IEEE 802.16x: Introduction to WMAN/IEEE 802.16x Technology,

IEEE 802.16Wireless MANs, IEEE 802.16 MAC Layer Details, IEEE 802.16 Physical Layer Details, IEEE 802.16 Physical Layer Details for 2-11 GHz, IEEE 802.16 Common System Operations.
Textbooks:
1. Gary J. Mullett, "Introduction to Wireless Telecommunications Systems and Networks", CENGAGE 2. UpenaDalal, "Wireless Communication", Oxford University Press, 2009
Reference Books:
1. Ke-Lin Du & M N S Swamy, "Wireless Communication System", Cambridge University Press, 2010 2. GottapuSasibhusan Rao, "Mobile Cellular Communication", 1st Edition, Pearson Education, 2012

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M.TECH. IN DIGITAL ELECTRONICS & COMMUNICATION SYSTEMS

COURSE STRUCTURE & SYLLABI

Course Code	EMBEDDED SYSTEMS DESIGN	L	T	P	C
21D06201		3	0	0	3
	Semester	II			

Course Objectives:

- To differentiate between a General purpose and an Embedded System.
- To provide knowledge on the building blocks of Embedded System.
- To understand the requirement of Embedded firmware and its role in API.

Course Outcomes (CO): Student will be able to

- Expected to differentiate the design requirements between General Purpose and Embedded Systems.
- Expected to acquire the knowledge of firmware design principles.
- Expected to understand the role of Real Time Operating System in Embedded Design.
- To acquire the knowledge and experience of task level Communication in any Embedded System.

UNIT - I Lecture Hrs:

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 Lecture Hrs:

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 Lecture Hrs:

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

UNIT - IV Lecture Hrs:

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

UNIT - V Lecture Hrs:

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.

Textbooks:

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

Reference Books:

1. Embedded Systems - Raj Kamal, TMH.
2. Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.
3. Embedded Systems – Lyla, Pearson, 2013
4. An Embedded Software Primer - David E. Simon, Pearson Education.

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M.TECH. IN DIGITAL ELECTRONICS & COMMUNICATION SYSTEMS

COURSE STRUCTURE & SYLLABI

Course Code	EMBEDDED REAL TIME OPERATING SYSTEMS	L	T	P	C
21D06203c		3	0	0	3
	Semester	II			

Course Objectives:

- To provide broad understanding of the requirements of Real Time Operating Systems.
- To make the student understand, applications of these Real Time features using case studies.
- To use the real time operating system concepts.

Course Outcomes (CO): Student will be able to

- Acquire knowledge on Real Time features of UNIX and LINUX.
- Understand the basic building blocks of Real Time Operating Systems in terms of scheduling, context switching and ISR.
- Understand on Real Time applications using Real Time Linux, ucos2, VX works, Embedded Linux.

UNIT - I		Lecture Hrs:

Introduction

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

UNIT - II		Lecture Hrs:

Real Time Operating Systems

Brief History of OS, Defining RTOS, The Scheduler, Objects, Services, Characteristics of RTOS, Defining a Task, asks States and Scheduling, Task Operations, Structure, Synchronization, Communication and Concurrency.

Defining Semaphores, Operations and Use, Defining Message Queue, States, Content, Storage, Operations and Use.

UNIT - III		Lecture Hrs:

Objects, Services and I/O

Pipes, Event Registers, Signals, Other Building Blocks, Component Configuration, Basic I/O Concepts, I/O Subsystem.

UNIT - IV		Lecture Hrs:

Exceptions, Interrupts and Timers

Exceptions, Interrupts, Applications, Processing of Exceptions and Spurious Interrupts, Real Time Clocks, Programmable Timers, Timer Interrupt Service Routines (ISR), Soft Timers, Operations.

UNIT - V		Lecture Hrs:

Case Studies of RTOS

RT Linux, MicroC/OS-II, Vx Works, Embedded Linux, and Tiny OS.

Textbooks:

1. Real Time Concepts for Embedded Systems – Qing Li, Elsevier, 2011.

Reference Books:

1. Embedded Systems- Architecture, Programming and Design by Rajkamal,TMH, 2007.
2. Advanced UNIX Programming, Richard Stevens.
3. Embedded Linux: Hardware, Software and Interfacing – Dr. Craig Hollabaugh.

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M.TECH. IN DIGITAL ELECTRONICS & COMMUNICATION SYSTEMS

COURSE STRUCTURE & SYLLABI

Course Code	EMBEDDED SYSTEMS PROTOCOLS	L	T	P	C
21D06301a		3	0	0	3
	Semester	II			

Course Objectives:

- To acquire knowledge on communication protocols of connecting Embedded Systems.
- To understand the design parameters of USB and CAN bus protocols.
- To understand the design issues of Ethernet in Embedded networks.
- To acquire the knowledge of wireless protocols in Embedded domain.

Course Outcomes (CO): Student will be able to

- Acquire knowledge on communication protocols of connecting Embedded Systems.
- Understand the design parameters of USB and CAN bus protocols.
- Understand the design issues of Ethernet in Embedded networks.
- Acquire the knowledge of wireless protocols in Embedded domain.

UNIT - I Lecture Hrs:

Embedded Communication Protocols

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

UNIT - II Lecture Hrs:

USB and CAN Bus

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

UNIT - III Lecture Hrs:

Ethernet Basics

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

UNIT - IV Lecture Hrs:

Embedded Ethernet

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

UNIT - V Lecture Hrs:

Wireless Embedded Networking

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

Textbooks:

1. Embedded Systems Design: A Unified Hardware/Software Introduction - Frank Vahid, Tony Givargis, John & Wiley Publications, 2002.
2. Parallel Port Complete: Programming, interfacing and using the PCs parallel printer port - Jan Axelson, Penram Publications, 1996.

Reference Books:

1. Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18F series - Dogan Ibrahim, Elsevier 2008.
2. Embedded Ethernet and Internet Complete - Jan Axelson, Penram publications, 2003.
3. Networking Wireless Sensors - BhaskarKrishnamachari, Cambridge press 2005.

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COURSE STRUCTURE & SYLLABI

Course Code	COGNITIVE RADIO	L	T	P	C
21D38203a		3	0	0	3
	Semester	II			

Course Objectives:

- To understand the fundamental concepts of cognitive radio networks.
- To develop the cognitive radio, as well as techniques for spectrum holes detection that cognitive radio takes advantages in order to exploit it.
- To understand technologies to allow an efficient use of TVWS for radio communications based on two spectrum sharing business models/policies.
- To understand fundamental issues regarding dynamic spectrum access, the radio-resource management and trading, as well as a number of optimization techniques for better spectrum exploitation.

Course Outcomes (CO):

Students will be able to

- Understand the fundamental concepts of cognitive radio networks.
- Develop the cognitive radio, as well as techniques for spectrum holes detection that cognitive radio takes advantages in order to exploit it.
- Understand technologies to allow an efficient use of TVWS for radio communications based on two spectrum sharing business models/policies.
- Understand fundamental issues regarding dynamic spectrum access, the radio-resource management and trading, as well as a number of optimization techniques for better spectrum exploitation.

UNIT - I | Lecture Hrs:

Introduction to Cognitive Radios: Digital dividend, cognitive radio (CR) architecture, functions of cognitive radio, dynamic spectrum access (DSA), components of cognitive radio, spectrum sensing, spectrum analysis and decision, potential applications of cognitive radio.

UNIT - II | Lecture Hrs:

Spectrum Sensing: Spectrum sensing, detection of spectrum holes (TVWS), collaborative sensing, geo-location database and spectrum sharing business models (spectrum of commons, real time secondary spectrum market).

UNIT - III | Lecture Hrs:

Optimization Techniques of Dynamic Spectrum Allocation: Linear programming, convex programming, non-linear programming, integer programming, dynamic programming, stochastic programming.

UNIT - IV | Lecture Hrs:

Dynamic Spectrum Access and Management: Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning algorithms and protocols.

UNIT - V | Lecture Hrs:

Spectrum Trading: Introduction to spectrum trading, classification to spectrum trading, radio resource pricing, brief discussion on economics theories in DSA (utility, auction theory), and classification of auctions (single auctions, double auctions, concurrent, sequential). Research Challenges in Cognitive Radio: Network layer and transport layer issues, cross layer design for cognitive radio networks.

Textbooks:

1. Ekram Hossain, DusitNiyato, Zhu Han, “Dynamic Spectrum Access and Management in Cognitive Radio Networks”, Cambridge University Press, 2009. 2. Kwang-Cheng Chen, Ramjee Prasad, “Cognitive radio networks”, John Wiley & Sons Ltd., 2009.
Reference Books:
1. Bruce Fette, “Cognitive radio technology”, Elsevier, 2nd edition, 2009. 2. HuseyinArslan, “Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems”, Springer, 2007. 3. Francisco Rodrigo Porto Cavalcanti, Soren Andersson, “Optimizing Wireless Communication Systems” Springer, 2009. 4. Linda Doyle, “Essentials of Cognitive Radio”, Cambridge University Press, 2009

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COURSE STRUCTURE & SYLLABI

Course Code	IMAGE AND VIDEO PROCESSING	L	T	P	C
21D38203b		3	0	0	3
Semester		II			

Course Objectives:

- To understand the quality improvement methods of Image.
- To study the basic digital image and video filter operations.
- To understand the fundamentals of Image Compression.
- To understand the Representation of video, principles and methods of motion estimation.

Course Outcomes (CO):

Student will be able to

- Understand the quality improvement methods of Image.
- Study the basic digital image and video filter operations.
- Understand the fundamentals of Image Compression.
- Understand the Representation of video, principles and methods of motion estimation.

UNIT - I Lecture Hrs:

Fundamentals of Image Processing and Image Transforms

Basic steps of Image Processing System Sampling and Quantization of an image, Basic relationship between pixels.

Image Segmentation

Segmentation concepts, Point, Line and Edge Detection, Thresholding, Region based segmentation.

UNIT - II Lecture Hrs:

Image Enhancement

Spatial domain methods: Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters.

Frequency domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, Selective filtering.

UNIT - III Lecture Hrs:

Image Compression

Image compression fundamentals - Coding Redundancy, Spatial and Temporal redundancy, Compression models: Lossy& Lossless, Huffman coding, , Bit plane coding, Transform coding, Predictive coding, Wavelet coding, Lossy Predictive coding, JPEG Standards.

UNIT - IV Lecture Hrs:

Basic Steps of Video Processing

Analog Video, Digital Video. Time-Varying Image Formation models: Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image Formation, Sampling of Video signals, Filtering operations.

UNIT - V Lecture Hrs:

2-D Motion Estimation

Optical flow, General Methodologies, Pixel Based Motion Estimation, Block- Matching Algorithm, Mesh based Motion Estimation, Global Motion Estimation, Region based Motion Estimation, Multi resolution motion estimation, Waveform based coding, Block based transform coding, Predictive coding, Application of motion estimation in Video coding.

Textbooks:

1. Digital Image Processing – Gonzaleze and Woods, 4^{rd} Ed., Pearson, 2018.
2. Digital Video Processing – M. Tekalp, Prentice Hall International

Reference Books:

1. Video Processing and Communication – Yao Wang, JoemOstermann and Ya–quin Zhang. 1^{st} Ed., PH Int.
2. Digital Image Processing – S.Jayaraman, S.Esakkirajan, T.Veera Kumar –TMH, 2009

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M.TECH. IN DIGITAL ELECTRONICS & COMMUNICATION SYSTEMS

COURSE STRUCTURE & SYLLABI

Course Code	ADHOC AND WIRELESS SENSOR NETWORKS	L	T	P	C
21D06204b		3	0	0	3
	Semester	III			

Course Objectives:

- To understand the various wireless networks
- To analyze MAC, routing and transport layer protocols
- To learn about the concepts of wireless sensor networks

Course Outcomes (CO):

Students will be able to

- Understand the various wireless networks
- Analyze MAC, routing and transport layer protocols
- Learn about the concepts of wireless sensor networks

UNIT - I		Lecture Hrs:

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		Lecture Hrs:

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		Lecture Hrs:

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		Lecture Hrs:

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 TransportLayer Protocol for Ad Hoc Wireless Networks.

UNIT - V		Lecture Hrs:

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.

Textbooks:

1. Ad Hoc Wireless Networks: Architectures and Protocols - C. Siva Ram Murthy and B. S. Manoj, 2004, PHI.
2. Wireless Ad- hoc and Sensor Networks: Protocols, Performance and Control – JagannathanSarangapani, CRC Press.

Reference Books:

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

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M.TECH. IN DIGITAL ELECTRONICS & COMMUNICATION SYSTEMS

COURSE STRUCTURE & SYLLABI

Course Code	NETWORK SECURITY AND CRYPTOGRAPHY LAB	L	T	P	C
21D38204		0	0	4	2
	Semester	II			

Course Objectives:

- To familiarize the concepts of network security and cryptographic algorithms
- To implement the network security and cryptographic algorithms for given specifications

Course Outcomes (CO):

- Familiarize the concepts of network security and cryptographic algorithms
- Implement the network security and cryptographic algorithms for given specifications.

List of Experiments:

1. Write a program to perform encryption and decryption using substitution and ransposition cipher.
2. Write a program to implement DES algorithm logic
3. Write a program for evaluation of AES
4. Write a program for evaluation Triple DES
5. Write a program to implement Blowfish algorithm logic
6. Write a program to implement RSA algorithm logic
7. Implement Diffie-Hellman key exchange mechanism using html
8. Write a program to implement Euclid algorithm
9. Calculate the message digest of a text using SHA-1 algorithm
10. Implement the signature scheme digital signature standard
11. Implement electronic mail security
12. Case study on web security requirement

Software Requirements:

C/C++/Java/Python

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COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED COMMUNICATIONS AND NETWORKS LAB	L	T	P	C
21D38205		0	0	4	2
	Semester	II			

Course Objectives:

- To implement digital filters for the given specifications
- To implement modulation schemes for the given specifications

Course Outcomes (CO):

Student will be able to

- Implement digital filters for the given specifications
- Implement modulation schemes for the given specifications

List of Experiments:

Student has to do minimum **TWELVE** experiments in the given list.

1. Implementation of Matched Filters.
2. Optimum receiver for the AWGN channel.
3. Design FIR (LP/HP/BP) filter using Window method.
4. Measurement of effect of Inter Symbol Interference.
5. Generation of constant envelope PSK signal wave form for different values of M.
6. Simulation of PSK system with M=4
7. Simulation of DPSK system with M=4
8. Design of FSK system
9. Simulation of correlation type demodulation for FSK signal
10. BPSK Modulation and Demodulation techniques
11. QPSK Modulation and Demodulation techniques
12. DQPSK Modulation and Demodulation techniques
13. 8-QAM Modulation and Demodulation techniques
14. DQAM Modulation and Demodulation techniques
15. Verification of Decimation and Interpolation of a given signal
16. Power spectrum estimation using AR model

Software Requirements:

MATLAB

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M.TECH. IN DIGITAL ELECTRONICS & COMMUNICATION SYSTEMS

COURSE STRUCTURE & SYLLABI

Course Code	VOICE AND DATA NETWORKS	L	T	P	C
21D38301		3	0	0	3
	Semester	III			

Course Objectives:

- To understand the protocols, algorithms, trade-offs rationale in voice and data networks.
- To understand the routing, transport, DNS resolutions in voice and data networks.
- To learn the network extensions and next generation architectures.

Course Outcomes (CO):

Students will be able to

- Understand the protocols, algorithms, trade-offs rationale in voice and data networks.
- Understand the routing, transport, DNS resolutions in voice and data networks.
- Learn the network extensions and next generation architectures.

UNIT - I Lecture Hrs:

Network Design Issues, Network Performance Issues, Network Terminology, centralized and distributed approaches for networks design, Issues in design of voice and data networks.

UNIT - II Lecture Hrs:

Layered and Layer less Communication, Cross layer design of Networks, Voice Networks (wired and wireless) and Switching, Circuit Switching and Packet Switching, Statistical Multiplexing.

UNIT - III Lecture Hrs:

Data Networks and their Design, Link layer design- Link adaptation, Link Layer Protocols, Retransmission. Mechanisms (ARQ), Hybrid ARQ (HARQ), Go Back N, Selective Repeat protocols and their analysis.

UNIT - IV Lecture Hrs:

Queuing Models of Networks, Traffic Models, Little's Theorem, Markov chains, M/M/1 and otherMarkov systems, Multiple Access Protocols, Aloha System, Carrier Sensing, Examples of Local area networks

UNIT - V Lecture Hrs:

Inter-networking, Bridging, Global Internet, IP protocol and addressing, Sub netting, Classless Inter domain Routing (CIDR), IP address lookup, Routing in Internet. End to End Protocols, TCP and UDP. Congestion Control, Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit/ Fast Recovery: Congestion avoidance, RED TCP Throughput Analysis, Quality of Service in Packet Networks. Network Calculus, Packet Scheduling Algorithms.

Textbooks:

1. D. Bertsekas and R. Gallager, "Data Networks", 2nd Edition, Prentice Hall, 1992.
2. L. Peterson and B. S. Davie, "Computer Networks: A Systems Approach",5th Edition, Morgan

Reference Books:

1. Kumar, D. Manjunath and J. Kuri, "Communication Networking: An analytical approach", 1st Edition, Morgan Kaufman, 2004.
2. Walrand, "Communications Network: A First Course", 2nd Edition, McGraw Hill, 2002.
3. Leonard Kleinrock, "Queueing Systems, Volume I: Theory", 1st Edition, John Wiley and Sons, 1975.

Course Code	IOT AND ITS APPLICATIONS	L	T	P	C
21D57204b		3	0	0	3
	Semester	II			

Course Objectives:

- To apply the Knowledge in IOT Technologies and Data management.
- To determine the values chains Perspective of M2M to IOT.
- To implement the state of the Architecture of an IOT.
- To compare IOT Applications in Industrial & real world.
- To demonstrate knowledge and understand the security and ethical issues of an IOT.

Course Outcomes (CO): Student will be able to

- Apply the Knowledge in IOT Technologies and Data management.
- Determine the values chains Perspective of M2M to IOT.
- Implement the state of the Architecture of an IOT.
- Compare IOT Applications in Industrial & real world.
- Demonstrate knowledge and understand the security and ethical issues of an IOT.

UNIT - I — Lecture Hrs:

Fundamentals of IoT: 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 — Lecture Hrs:

IoT Protocols: 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 — Lecture Hrs:

Design and Development: 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 — Lecture Hrs:

Data Analytics and Supporting Services: 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 — Lecture Hrs:

Case Studies/Industrial Applications: 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).

Textbooks:

1. 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.

2. Internet of Things – A hands-on approach, ArshdeepBahga, Vijay Madisetti, Universities Press,2015
Reference Books:
1. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012 (for Unit 2). 2. "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. 3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer, 2011.

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M.TECH. IN DIGITAL ELECTRONICS & COMMUNICATION SYSTEMS

COURSE STRUCTURE & SYLLABI

Course Code	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	L	T	P	C
21D38301b		3	0	0	3
	Semester	III			

Course Objectives:

- To learn the difference between optimal reasoning vs human like reasoning
- To understand the notions of state space representation, exhaustive search, heuristic search along with the time and space complexities
- To learn different knowledge representation techniques
- To understand the applications of AI: namely Game Playing, Theorem Proving, Expert Systems, Machine Learning and Natural. Language Processing

Course Outcomes (CO): Student will be able to

- Possess the ability to formulate an efficient problem space for a problem expressed in English.
- Possess the ability to select a search algorithm for a problem and characterize its time and space complexities.
- Possess the skill for representing knowledge using the appropriate technique.
- Possess the ability to apply AI techniques to solve problems of Game Playing, Expert Systems, Machine Learning and Natural Language Processing.

UNIT - I		Lecture Hrs:

Introduction, History, Intelligent Systems, Foundations of AI, Sub areas of AI, Applications. Problem Solving – State-Space Search and Control Strategies: Introduction, General Problem Solving, Characteristics of Problem, Exhaustive Searches, Heuristic Search Techniques, Iterative-Deepening A*, Constraint Satisfaction. Game Playing, Bounded Look-ahead Strategy and use of Evaluation Functions, Alpha-Beta Pruning

UNIT - II		Lecture Hrs:

Logic Concepts and Logic Programming
Introduction, Propositional Calculus, Propositional Logic, Natural Deduction System, Axiomatic System, Semantic Tableau System in Propositional Logic, Resolution Refutation in Propositional Logic, Predicate Logic, Logic Programming. Knowledge Representation: Introduction, Approaches to Knowledge Representation, Knowledge Representation using Semantic Network, Extended Semantic Networks for KR, Knowledge Representation using Frames.

UNIT - III		Lecture Hrs:

Expert System and Applications
Introduction, Phases in Building Expert Systems, Expert System Architecture, Expert Systems Vs Traditional Systems, Truth Maintenance Systems, Application of Expert Systems, List of Shells and Tools. Uncertainty Measure – Probability Theory: Introduction, Probability Theory, Bayesian Belief Networks, Certainty Factor Theory, Dempster-Shafer Theory.

UNIT - IV		Lecture Hrs:

Machine-Learning Paradigms
Introduction. Machine Learning Systems.Supervised and Unsupervised Learning. Inductive Learning. Learning Decision Trees (Text Book 2), Deductive Learning. Clustering, Support Vector Machines. Artificial Neural Networks: Introduction, Artificial Neural Networks, Single- Layer Feed-Forward Networks, Multi-Layer Feed-Forward Networks, Radial- Basis Function Networks, Design Issues of Artificial Neural Networks, Recurrent Networks.

UNIT - V		Lecture Hrs:

Advanced Knowledge Representation Techniques
Case Grammars, Semantic Web Natural Language Processing: Introduction, Sentence Analysis

Phases, Grammars and Parsers, Types of Parsers, Semantic Analysis, Universal Networking Knowledge.
Textbooks:
1.Saroj Kaushik. Artificial Intelligence. Cengage Learning, 2011. 2.Russell, Norvig: Artificial intelligence, A Modern Approach, Pearson Education, Second Edition. 2004.
Reference Books:
1. Rich, Knight, Nair: Artificial intelligence, Tata McGraw Hill, Third Edition 2009.

AUDIT COURSE-I

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M.TECH. IN DIGITAL ELECTRONICS & COMMUNICATION SYSTEMS

COURSE STRUCTURE & SYLLABI

Course Code	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
21DAC101a		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- Understand the essentials of writing skills and their level of readability
- Learn about what to write in each section
- Ensure qualitative presentation with linguistic accuracy

Course Outcomes (CO): Student will be able to

- Understand the significance of writing skills and the level of readability
- Analyze and write title, abstract, different sections in research paper
- Develop the skills needed while writing a research paper

UNIT - I		Lecture Hrs:10

1Overview of a Research Paper- Planning and Preparation- Word Order- Useful Phrases - Breaking up Long Sentences-Structuring Paragraphs and Sentences-Being Concise and Removing Redundancy -Avoiding Ambiguity

UNIT - II		Lecture Hrs:10

Essential Components of a Research Paper- Abstracts- Building Hypothesis-Research Problem - Highlight Findings- Hedging and Criticizing, Paraphrasing and Plagiarism, Cauterization

UNIT - III		Lecture Hrs:10

Introducing Review of the Literature – Methodology - Analysis of the Data-Findings - Discussion-Conclusions-Recommendations.

UNIT - IV		Lecture Hrs:9

Key skills needed for writing a Title, Abstract, and Introduction

UNIT - V		Lecture Hrs:9

Appropriate language to formulate Methodology, incorporate Results, put forth Arguments and draw Conclusions

Suggested Reading

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) Model Curriculum of Engineering & Technology PG Courses [Volume-I]
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman’sbook
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

M.TECH. IN DIGITAL ELECTRONICS & COMMUNICATION SYSTEMS

COURSE STRUCTURE & SYLLABI

Course Code	DISASTER MANAGEMENT	L	T	P	C
21DAC101b		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- Learn to demonstrate critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluatedisasterriskreduction and humanitarian response policy and practice from Multiple perspectives.
- Developanunderstandingofstandardsofhumanitarianresponseandpracticalrelevanceinspecific types of disasters and conflict situations
- Criticallyunderstandthestrengthsandweaknessesofdisastermanagementapproaches,planningand programming in different countries, particularly their home country or the countries they work in

UNIT - I

Introduction:
Disaster:Definition,FactorsandSignificance;DifferenceBetweenHazardandDisaster;Naturaland Manmade Disasters: Difference, Nature, Types and Magnitude.

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:
Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes,Volcanisms,Cyclones,Tsunamis,Floods,DroughtsandFamines,Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT - III

Disaster Preparedness and Management:
Preparedness: Monitoring of Phenomena Triggering ADisasteror Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT - IV

Risk Assessment Disaster Risk:
Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. TechniquesofRiskAssessment,GlobalCo-OperationinRiskAssessmentand Warning, People's Participation in Risk Assessment. Strategies for Survival.

UNIT - V

Disaster Mitigation:
Meaning,ConceptandStrategiesofDisasterMitigation,EmergingTrendsInMitigation.Structural Mitigationand Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Suggested Reading

1. R.Nishith,SinghAK,“DisasterManagementinIndia:Perspectives,issuesandstrategies
2. “’New Royal book Company..Sahni,PardeepEt.Al.(Eds.),”DisasterMitigationExperiencesAndReflections”,PrenticeHall OfIndia, New Delhi.
3. GoelS.L.,DisasterAdministrationAndManagementTextAndCaseStudies”,Deep&Deep Publication Pvt. Ltd., New Delhi

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M.TECH. IN DIGITAL ELECTRONICS & COMMUNICATION SYSTEMS

COURSE STRUCTURE & SYLLABI

Course Code	SANSKRITFOR TECHNICAL KNOWLEDGE	L	T	P	C
21DAC101c		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- LearningofSanskrittodevelopthelogicinmathematics,science&othersubjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge
- Knowledge from ancientliterature

Course Outcomes (CO): Student will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science &technology can be understood
- Being a logical language will help to develop logic in students

UNIT - I

Alphabets in Sanskrit,

UNIT - II

Past/Present/Future Tense, Simple Sentences

UNIT - III

Order, Introduction of roots

UNIT - IV

Technical information about Sanskrit Literature

UNIT - V

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested Reading

1.“Abhyaspustakam” –Dr.Vishwas, Sanskrit-Bharti Publication, New Delhi
2.“Teach Yourself Sanskrit” Prathama Deeksha- VempatiKutumbshastri, RashtriyaSanskrit Sansthanam, New Delhi Publication
3.“India’s Glorious ScientificTradition” Suresh Soni, Ocean books (P) Ltd.,New Delhi

AUDIT COURSE-II

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M.TECH. IN DIGITAL ELECTRONICS & COMMUNICATION SYSTEMS

COURSE STRUCTURE & SYLLABI

Course Code	PEDAGOGY STUDIES	L	T	P	C
21DAC201a		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

- Reviewexistingevidenceonthereviewtopictoinformprogrammedesignandpolicy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes (CO): Student will be able to

Students will be able to understand:

- Whatpedagogicalpracticesarebeingusedbyteachersinformalandinformalclassrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- Howcanteachereducation(curriculumandpracticum)andtheschoolcurriculumand guidance materials best support effective pedagogy?

UNIT - I

Introduction and Methodology: Aims and rationale, Policy back ground, Conceptual frame work and terminology Theories oflearning,Curriculum,Teachereducation.Conceptualframework,Research questions**.** Overview of methodology and Searching.

UNIT - II

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT - III

Evidence on theeffectivenessofpedagogicalpractices,Methodologyfortheindepthstage:quality assessmen t of included studies. How can teacher education (curriculumandpracticum) andthescho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of th body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT - IV

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacherandthecommunity.Curriculumandassessment,Barrierstolearning:limitedresourcesand large class sizes

UNIT - V

Researchgapsandfuturedirections: Researchdesign**,**Contexts**,**Pedagogy**,**Teachereducation**,** Curriculum and assessment**,** Dissemination and research impact.

Suggested Reading

1. AckersJ,HardmanF(2001)ClassroominteractioninKenyanprimaryschools,Compare, 31 (2): 245-261.
2. AgrawalM(2004)Curricularreforminschools:Theimportanceofevaluation,Journalof

3. Curriculum Studies, 36 (3): 361-379.
4. AkyeampongK(2003) Teacher training in Ghana - does it count? Multi-site teachereducation research project (MUSTER) country report 1. London: DFID.
5. Akyeampong K, LussierK, PryorJ, Westbrook J (2013)Improving teaching and learning of basic maths and reading in Africa: Does teacherpreparation count?International Journal Educational Development, 33 (3): 272–282.
6. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
   Chavan M (2003)ReadIndia: A mass scale, rapid, 'learning to read'campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Code	STRESSMANAGEMENT BY YOGA	L	T	P	C
21DAC201b		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

- To achieve overall health of body and mind
- To overcome stres

Course Outcomes (CO): Student will be able to

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT - I

Definitions of Eight parts of yog.(Ashtanga)

UNIT - II

Yam and Niyam.

UNIT - III

Do`sand Don't'sin life.

i) Ahinsa,satya,astheya,bramhacharyaand aparigrahaii) Shaucha,santosh,tapa,swadhyay,ishwarpranidhan

UNIT - IV

Asan and Pranayam

UNIT - V

i)Variousyogposesand theirbenefitsformind &body

ii)Regularizationofbreathingtechniques and its effects-Types ofpranayam

Suggested Reading

1.'Yogic Asanas forGroupTarining-Part-I": Janardan SwamiYogabhyasiMandal, Nagpur
2."Rajayogaor conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course Code	PERSONALITY DEVELOPMENT THROUGHLIFE ENLIGHTENMENTSKILLS	L	T	P	C
21DAC201c		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

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

Course Outcomes (CO): Student will be able to

- StudyofShrimad-Bhagwad-Geetawillhelpthestudentindevelopinghispersonalityand achieve the highest goal in life
- The person who has studied Geetawilllead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT - I

Neetisatakam- Holistic development of personality
Verses-19,20,21,22(wisdom)
Verses-29,31,32(pride &heroism)
Verses-26,28,63,65(virtue)

UNIT - II

Neetisatakam- Holistic development of personality
Verses-52,53,59(dont's)
Verses-71,73,75,78(do's)

UNIT - III

Approach to day to day work and duties.
ShrimadBhagwadGeeta:Chapter2-Verses41,47,48,
Chapter3-Verses13,21,27,35,Chapter6-Verses5,13,17,23,35,
Chapter18-Verses45,46,48.

UNIT - IV

Statements of basic knowledge.
ShrimadBhagwadGeeta:Chapter2-Verses 56,62,68
Chapter12 -Verses13,14,15,16,17,18
Personality of Rolemodel. Shrimad Bhagwad Geeta:

UNIT - V

Chapter2-Verses 17,Chapter3-Verses36,37,42,
Chapter4-Verses18,38,39
Chapter18– Verses37,38,63

Suggested Reading

1."SrimadBhagavadGita"bySwamiSwarupanandaAdvaitaAshram(PublicationDepartment), Kolkata
2.Bhartrihari'sThree Satakam (Niti-sringar-vairagya) by P.Gopinath, RashtriyaSanskrit Sansthanam, New Delhi.

OPEN ELECTIVE

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M.TECH. IN DIGITAL ELECTRONICS & COMMUNICATION SYSTEMS

COURSE STRUCTURE & SYLLABI

Course Code	INDUSTRIAL SAFETY	L	T	P	C
21DOE301b		3	0	0	3
	Semester		III		

Course Objectives:

- To know about Industrial safety programs and toxicology, Industrial laws , regulations and source models
- To understand about fire and explosion, preventive methods, relief and its sizing methods
- To analyse industrial hazards and its risk assessment.

Course Outcomes (CO): Student will be able to

- To list out important legislations related to health, Safety and Environment.
- To list out requirements mentioned in factories act for the prevention of accidents.
- To understand the health and welfare provisions given in factories act.

UNIT - I Lecture Hrs:

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT - II Lecture Hrs:

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT - III Lecture Hrs:

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working andapplications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT - IV Lecture Hrs:

Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT - V Lecture Hrs:

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Textbooks:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.

Reference Books:

1. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
2. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Course Code	BUSINESS ANALYTICS	L	T	P	C
21DOE301c		3	0	0	3
Semester		III			

Course Objectives:

- The main objective of this course is to give the student a comprehensive understanding of business analytics methods.

Course Outcomes (CO): Student will be able to

- Students will demonstrate knowledge of data analytics.
- Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
- Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
- Students will demonstrate the ability to translate data into clear, actionable insights.

UNIT - I — Lecture Hrs:

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst.
Stakeholders: the project team, management, and the front line, Handling Stakeholder Conflicts.

UNIT - II — Lecture Hrs:

Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

UNIT - III — Lecture Hrs:

Forming Requirements: Overview of Requirements, Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

UNIT - IV — Lecture Hrs:

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements. Managing Requirements Assets: Change Control, Requirements Tools

UNIT - V — Lecture Hrs:

Recent Trands in: Embedded and colleborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

Textbooks:

1. Business Analysis by James Cadle et al.
2. Project Management: The Managerial Process by Erik Larson and, Clifford Gray

Reference Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

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M.TECH. IN DIGITAL ELECTRONICS & COMMUNICATION SYSTEMS

COURSE STRUCTURE & SYLLABI

Course Code	WASTE TO ENERGY	L	T	P	C
21DOE301e		3	0	0	3
	Semester	III			

Course Objectives:

- Introduce and explain energy from waste, classification and devices to convert waste to energy.
- To impart knowledge on biomass pyrolysis, gasification, combustion and conversion process.
- To educate on biogas properties ,bio energy system, biomass resources and their classification and biomass energy programme in India.

Course Outcomes (CO): Student will be able to

- To know about overview of Energy to waste and classification of waste.
- To acquire knowledge on bio mass pyrolysis, gasification, combustion and conversion process in detail.
- To gain knowledge on properties of biogas, biomass resources and programmes to convert waste to energy in India.

UNIT - I — Lecture Hrs:10

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT - II — Lecture Hrs:10

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT - III — Lecture Hrs:12

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation

UNIT - IV — Lecture Hrs:12

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

UNIT - V — Lecture Hrs:10

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification -

Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification- pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Textbooks:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 2018
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., TMH, 2017

Reference Books:

1. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996

Online Learning Resources:
https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-ch13/ https://www.youtube.com/watch?v=x2KmjbCvKTk

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M.TECH. IN VLSI/VLSI DESIGN/VLSI YSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

SEMESTER – I

S. No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D57101	CMOS Analog IC Design	PC	3	0	0	3
2.	21D57102	CMOS Digital IC Design	PC	3	0	0	3
3.	21D57103a 21D57103b 21D57103c	**Program Elective – 1** Microchip Fabrication Techniques Nanomaterials and Nanotechnology CAD for VLSI	PE	3	0	0	3
4.	21D57104a 21D57104b 21D57104c	**Program Elective – 1** Device Modelling FPGA Architectures and Applications ASIC Design	PE	3	0	0	3
5.	21D57105	CMOS Analog IC Design Lab	PC	0	0	4	2
6.	21D57106	CMOS Digital IC Design Lab	PC	0	0	4	2
7.	21DRM101	Research Methodology and IPR	MC	2	0	0	2
8.	21DAC101a 21DAC101b 21DAC101c	**Audit Course – I** English for Research paper writing Disaster Management Sanskrit for Technical Knowledge	AC	2	0	0	0
Total							**18**

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M.TECH. IN VLSI/VLSI DESIGN/VLSI YSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

SEMESTER – II

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	21D57201	CMOS Mixed Signal IC Design	PC	3	0	0	3
2.	21D57202	Physical Design Automation	PC	3	0	0	3
3.	21D57203a 21D57203b 21D57203c	**Program Elective – III** SoC Testing and Verification Semiconductor Memory Design and Testing MEMS System Design	PE	3	0	0	3
4.	21D57204a 21D57204b 21D57204c	**Program Elective – IV** Low Power VLSI Design IoT and its Applications VLSI Signal Processing	PE	3	0	0	3
5.	21D57205	CMOS Mixed Signal IC Design Lab	PC	0	0	4	2
6.	21D57206	Physical Design Automation Lab	PC	0	0	4	2
7.	21D57207	Technical seminar	PR	0	0	4	2
8.	21DAC201a 21DAC201b 21DAC201c	**Audit Course – II** Pedagogy Studies Stress Management for Yoga Personality Development through Life Enlightenment Skills	AC	2	0	0	0
		Total					**18**

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SEMSTER - III

S.No.	Course codes	Course Name	Category	Hours per L	T	P	Credits
1.	 21D57301a 21D57301b 21D06203a	**Program Elective – V** Bi-CMOS Technology and Applications Optimization Techniques and Applications in VLSI Design SoC Architecture	PE	3	0	0	3
2.	 21DOE301b 21DOE301c 21DOE301e	**Open Elective** Industrial Safety Business Analytics Waste to Energy	OE	3	0	0	3
3.	21D57302	Dissertation Phase – I	PR	0	0	20	10
4.	21D57303	Co-curricular Activities					2
		Total					**18**

SEMESTER - IV

S.No.	Course codes	Course Name	Category	Hours per L	T	P	Credits
1.	21D57401	Dissertation Phase – II	PR	0	0	32	16
		Total					**16**

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M.TECH. IN VLSI/VLSI DESIGN/VLSI YSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

Course Code	**CMOS ANALOG IC DESIGN**	**L**	**T**	**P**	**C**
21D57101		**3**	**0**	**0**	**3**
	Semester	**I**			

Course Objectives:

- This course focuses on theory, analysis and design of analog integrated circuits in both Bipolar and Metal-Oxide-Silicon (MOS) technologies.
- Basic design concepts, issues and tradeoffs involved in analog IC design are explored.
- Intuitive understanding and real-life applications are emphasized throughout the course.
- To learn about Design of CMOS Op Amps, Compensation of Op Amps, Design of Two-Stage Op Amps, Power Supply Rejection Ratio of Two-Stage Op Amps, Cascade Op Amps, Measurement Techniques of OP Amp.
- To know about Characterization of Comparator, Two-Stage, Open-Loop Comparators, Improving the Performance of Open-Loop Comparators, Discrete-Time Comparators etc.

Course Outcomes (CO): Student will be able to

- Design MOSFET based analog integrated circuits.
- Analyze analog circuits at least to the first order.
- Appreciate the trade-offs involved in analog integrated circuit design.
- Understand and appreciate the importance of noise and distortion in analog circuits.
- Analyze complex engineering problems critically in the domain of analog IC design for conducting research.
- Solve engineering problems for feasible and optimal solutions in the core area

UNIT - I — Lecture Hrs:

Basic MOS Device Physics: 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 — Lecture Hrs:

Differential Amplifiers: 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 — Lecture Hrs:

Frequency Response of Amplifiers: 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 — Lecture Hrs:

Feedback Amplifiers: 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 — Lecture Hrs:

Comparators: Characterization of comparator, Two-Stage, Open-Loop comparators, Other Open-Loop Comparators, Improving the Performance of Open-Loop Comparators, Discrete-Time Comparators.

Textbooks:

1. B.Razavi, "Design of Analog CMOS Integrated Circuits", 2nd Edition, McGraw Hill Edition2016.
2. Paul.R.Gray& Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley,

5thEdition, 2009.
Reference Books:
1.T.C.Carusone, D.A.Johns&K.Martin, "Analog Integrated Circuit Design", 2ndEdition, Wiley, 2012. 2. P.E.Allen&D.R.Holberg, "CMOS Analog Circuit Design", 3rd Edition, Oxford University Press, 2011. 3. R.Jacob Baker, "CMOS Circuit Design, Layout, and Simulation", 3rdEdition, Wiley, 2010. 4. Adel S. Sedra, Kenneth C. Smith, Arun, "Microelectronic Circuits", 6thEdition, Oxford University Press

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COMMON COURSE STRUCTURE & SYLLABI

Course Code	CMOS DIGITAL IC DESIGN	L	T	P	C
21D57102		3	0	0	3
	Semester	I			

Course Objectives:

- To understand the fundamental properties of digital Integrated circuits using basic MOSFET equations and to develop skills for various logic circuits using CMOS related design styles.
- The course also involves analysis of performance metrics.
- To teach fundamentals of CMOS Digital integrated circuit design such as importance of Pseudo logic, Combinational MOS logic circuits and Sequential MOS logic circuits.
- To teach the fundamentals of Dynamic logic circuits and basic semiconductor memories which are the basics for the design of high performance digital integrated circuits.

Course Outcomes (CO): Student will be able to

- Demonstrate advanced knowledge in Static and dynamic characteristics of CMOS,
- Estimate Delay and Power of Adders circuits.
- Classify different semiconductor memories.
- Analyze, design and implement combinational and sequential MOS logic circuits.
- Analyze complex engineering problems critically in the domain of digital IC design for conducting research.
- Solve engineering problems for feasible and optimal solutions in the core area of digital ICs

UNIT - I — Lecture Hrs:

MOS Design Pseudo NMOS Logic: 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 — Lecture Hrs:

Combinational MOS Logic Circuits: 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 — Lecture Hrs:

Sequential MOS Logic Circuits: Behavior of bistable elements, SR Latch, Clocked latch and flip flop circuits, CMOS D latch and edge triggered flip-flop

UNIT - IV — Lecture Hrs:

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

UNIT - V — Lecture Hrs:

Semiconductor Memories: 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.

Textbooks:

1. Neil Weste, David Harris, “CMOS VLSI Design: A Circuits and Systems Perspective”, 4th Edition, Pearson, 2010
2. Digital Integrated Circuit Design – Ken Martin, Oxford University Press, 2011.
3. CMOS Digital Integrated Circuits Analysis and Design – Sung-Mo Kang, Yusuf Leblebici, TMH, 3rd Edition, 2011.

Reference Books:

1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press, 2011
2. Digital Integrated Circuits – A Design Perspective, Jan M.Rabaey, AnanthaChandrakasan, Borivoje Nikolic, 2ndEdition, PHI.

Course Code	MICROCHIP FABRICATION TECHNIQUES	L	T	P	C
21D57103a		3	0	0	3
	Semester	I			

Course Objectives:

- Comprehend impact of semiconductor industry on the design of development of integrated circuits.
- Acquaint with clean room technology
- Understand oxidation methods, aspects of photolithography, diffusion, ion implantation techniques.
- Specify NMOS and CMOS design rules corresponding to 180nm, 90nm and 45nm technologies
- Understand packaging principles

Course Outcomes (CO): Student will be able to

- Understand various stages of fabrication
- Understand Various packaging techniques and Design rules.
- Classify various thin films and its characteristics.

UNIT - I — Lecture Hrs:

Introduction to Processing: Overview of semiconductor industry, Stages of Manufacturing, Process and product trends, Crystal growth, Basic wafer fabrication operations, process yields, Semiconductor material preparation, Yield measurement, Contamination sources, Clean room construction.

UNIT - II — Lecture Hrs:

Photolithography: Oxidation and Photolithography, Ten step patterning process, Photoresists, physical properties of photoresists, Storage and control of photoresists, photo masking process, Hard bake, develop inspect, Dry etching Wet etching, resist stripping.

UNIT - III — Lecture Hrs:

Diffusion & Ion Implantation: Doping and depositions: Diffusion process steps, deposition, Drive-in oxidation, Ion implantation-1, Ion implantation-2.

UNIT - IV — Lecture Hrs:

Film Depositions and Growth: Metallization, CVD basics, CVD process steps, Low pressure CVD systems, Plasma enhanced CVD systems, Vapour phase epitaxy, molecular beam epitaxy.

UNIT - V — Lecture Hrs:

Yield: Design rules and Scaling, BICMOS ICs: Choice of transistor types, PNP transistors, Resistors, capacitors.
Packaging: Chip characteristics, package functions, package operations.

Textbooks:

1. Peter Van Zant, Microchip fabrication, McGraw Hill, 1997.
2. Plummer, J.D., Deal, M.D. and Griffin, P.B., “Silicon VLSI Technology: Fundamentals, Practice and Modeling”, 3rd Ed., Prentice-Hall, 2000.

Reference Books

1. C.Y. Chang and S.M. Sze, ULSI technology, McGraw Hill, 2000
2. S.K. Gandhi, VLSI Fabrication principles, John Wiley and Sons, NY, 1994
3. S.M. Sze, VLSI technology, McGraw-Hill Book company, NY, 1988

Course Code	NANOMATERIALS AND NANOTECHNOLOGY	L	T	P	C
21D57103b		3	0	0	3
	Semester	I			

Course Objectives:

- To understand the basic idea behind the design and fabrication of nano scale systems.
- To understand and frmulate new engineering solutions for current problems and technologies for future applications.
- To acquire knowledge on the operation of fabrication and characterization devices to achieve precisely designed systems.

Course Outcomes (CO): Student will be able to

- Understand the basic science behind the design and fabrication of nano scale systems.
- Understand and formulate new engineering solutions for current problems and competing technologies for future applications.
- Make inter disciplinary projects applicable to wide areas by clearing and fixing the boundaries in system development.
- Gather detailed knowledge of the operation of fabrication and characterization devices to achieve precisely designed systems.

UNIT - I — Lecture Hrs:

Introduction of nano materials and nanotechnologies, Features of nanostructures, Applications of nano materials and technologies. Nano dimensional Materials 0D, 1D, 2D structures – Size Effects – Fraction of Surface Atoms –Specific Surface Energy and Surface Stress – Effect on the Lattice Parameter – Phonon Density of States – the General Methods available for the Synthesis of Nanostructures – precipitate – reactive– hydrothermal/solvo thermal methods – suitability of such methods for scaling – potential Uses.

UNIT - II — Lecture Hrs:

Fundamentals of nanomaterials, Classification, Zero-dimensional nanomaterials, One-dimensional nanomaterials, Two-dimensional nano materials, three dimensional nanomaterials.Low Dimensional Nanomaterials and its Applications, Synthesis, Properties and applications of Low Dimensional Carbon-Related Nanomaterials.

UNIT - III — Lecture Hrs:

Micro- and Nanolithography Techniques, Emerging Applications, Introduction to Micro electro mechanical Systems (MEMS), Advantages and Challenges of MEMS, Fabrication Technologies, Surface Micromachining, Bulk Micromachining, Molding. Introduction to Nano Phonics.

UNIT - IV — Lecture Hrs:

Introduction, Synthesis of CNTs - Arc-discharge, Laser-ablation, Catalytic growth, Growth mechanisms of CNT‟s - Multi-walled nanotubes, Single-walled nano tubes Optical properties of CNT‟s, Electrical transport in perfect nanotubes, Applications as case studies. Synthesis and Applications of CNTs.

UNIT - V — Lecture Hrs:

Ferroelectric materials, coating, molecular electronics and Nano electronics, biological and environmental, membrane based application, polymer based application.

Textbooks:

1. Kenneth J.Klabunde and Ryan M.Richards, "Nanoscale Materials in Chemistry", 2ndedition, John Wiley and Sons, 2009.
2. I Gusev and A Rempel, "Nanocrystalline Materials", Cambridge International Science Publishing, 1stIndian edition by Viva Books Pvt. Ltd. 2008.

3. B.S.Murty,P.Shankar,Baldev Raj, B.B.Rath, James Murday, "Nanoscience and Nanotechnology", Tata McGrawHill Education 2012.
Reference Books:
1. Digital Integrated Circuit Design – Ken Martin, Oxford University Press, 2011. 2. Digital Integrated Circuits - A Design Perspective, Jan M.Rabaey, AnantChandrakasan, Borvivoje Nikolic, 2nd Edition, PHI.

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COMMON COURSE STRUCTURE & SYLLABI

Course Code	CAD FOR VLSI	L	T	P	C
21D57103c		3	0	0	3
	Semester	I			

Course Objectives:

- To understand the various phases of CAD for digital electronic systems, from digital logic simulation to physical design, including test and verification.
- To demonstrate knowledge and understanding of fundamental concepts in CAD and to establish capability for CAD tool development and enhancement.
- To practice the application of fundamentals of VLSI technologies
- To optimize the implemented design for area, timing and power by applying suitable constraints.

Course Outcomes (CO): Student will be able to

- Establish comprehensive understanding of the various phases of CAD for digital electronic systems, from digital logic simulation to physical design, including test and verification.
- Demonstrate knowledge and understanding of fundamental concepts in CAD and to establish capability for CAD tool development and enhancement.
- Practice the application of fundamentals of VLSI technologies
- Optimize the implemented design for area, timing and power by applying suitable constraints.

UNIT - I — Lecture Hrs:

Introduction :VLSI Design Cycle, New Trends in VLSI Design Cycle, Physical Design Cycle, New Trends in Physical Design Cycle, Design Styles, System Packaging Styles.

UNIT - II — Lecture Hrs:

Partitioning : Partitioning, Pin Assignment and Placement: Partitioning – Problem formulation, Classification of Partitioning algorithms, Kernighan-Lin Algorithm, Simulated Annealing.

UNIT - III — Lecture Hrs:

Floor Planning : Floor Planning – Problem formulation, Classification of floor planning algorithms, constraint based floor planning, Rectangular Dualization, Pin Assignment – Problem formulation, Classification of pin assignment algorithms, General and channel Pin assignments.

UNIT - IV — Lecture Hrs:

Placement and Routing : Placement–Problem formulation, Classification of placement algorithms, Partitioning based placement algorithms.

Global Routing and Detailed Routing: Global Routing – Problem formulation, Classification of global routing algorithms, Maze routing algorithms, Detailed Routing – Problem formulation, Classification of routing algorithms, Single layer routing algorithms.

UNIT - V — Lecture Hrs:

Physical Design Automation of FPGAs and MCMs: FPGA Technologies, Physical Design cycle for FPGAs, Partitioning, Routing – Routing Algorithm for the Non-Segmented model, Routing Algorithms for the Segmented Model; Introduction to MCM Technologies, MCM Physical Design Cycle.

Textbooks:

1. Algorithms for VLSI Physical Design Automation by Naveed Shervani, 3^{rd} Edition, 2005, Springer International Edition.
2. CMOS Digital Integrated Circuits Analysis and Design – Sung-Mo Kang, Yusuf Leblebici, TMH, 3rd Ed., 2011.

Reference Books:

1. VLSI Physical Design Automation-Theory and Practice by Sadiq M Sait, Habib Youssef, World Scientific.
2. Algorithms for VLSI Design Automation, S. H. Gerez, 1999, Wiley student Edition, John Wiley and Sons (Asia) Pvt. Ltd.
3. VLSI Physical Design Automation by Sung Kyu Lim, Springer International Edition

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M.TECH. IN VLSI/VLSI DESIGN/VLSI YSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

Course Code	DEVICE MODELLING	L	T	P	C
21D57104a		3	0	0	3
	Semester	I			

Course Objectives:

- To understand the physics of 2-terminal MOS operation and its characteristics
- To understand the physics of 4-terminal MOSFET operation and its characteristics.
- To analyze the SOI MOSFET electrical characteristics.

Course Outcomes (CO): Student will be able to

- Understand the physics of 2-terminal MOS operation and its characteristics
- Understand the physics of 4-terminal MOSFET operation and its characteristics.
- Analyze the SOI MOSFET electrical characteristics.

UNIT - I		Lecture Hrs:

2-terminal MOS device: threshold voltage modelling (ideal case as well as considering the effects of Qf, Φms and Dit.).

UNIT - II		Lecture Hrs:

C-V characteristics (ideal case as well as taking into account the effects of Qf, Φms and Dit);MOS capacitor as a diagnostic tool (measurement of non-uniform doping profile, estimation of Qf, Φms and Dit)

UNIT - III		Lecture Hrs:

4-terminal MOSFET: threshold voltage (considering the substrate bias); above threshold I-V modelling (SPICE level 1,2,3 and 4).

UNIT - IV		Lecture Hrs:

Sub threshold current model; scaling; effect of threshold tailoring implant (analytical modelling of threshold voltage using box approximation); buried channel MOSFET. Short channel, DIBL and narrow width effects; small signal analysis of MOSFETs (Meyer's model)

UNIT - V		Lecture Hrs:

SOI MOSFET: Basic structure; threshold voltage modelling Advanced topics: hot carriers in channel; EEPROMs; CCDs; high-K gate dielectrics.

Textbooks:

1. S. M. Sze, Physics of Semiconductor Devices, (2e), Wiley Eastern, 1981.
2. M. Lundstrom, Fundamentals of Nanotransistors, World Scientific Publishing Co Pte Ltd 2017.

Reference Books

1. Y. P. Tsividis, Operation and Modelling of the MOS Transistor, McGraw-Hill, 1987.
2. E. Takeda, Hot-carrier Effects in MOS Trasistors, Academic Press, 1995.
3. J. P. Colinge, "FinFETs and Other Multi-Gate Transistors," Springer. 2009

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COMMON COURSE STRUCTURE & SYLLABI

Course Code	FPGA ARCHITECTURES AND APPLICATIONS	L	T	P	C
21D57104b		3	0	0	3
	Semester	I			

Course Objectives:

- To acquire knowledge about various architectures and device technologies of PLD's.
- To comprehend FPGA Architectures.
- To analyze System level Design and their application for Combinational and Sequential Circuits.
- To familiarize with Anti-Fuse Programmed FPGAs.
- To apply knowledge of this subject for various design applications.

Course Outcomes (CO): Student will be able to

- Acquire knowledge about various architectures and device technologies of PLD's.
- Comprehend FPGA Architectures.
- Analyze System level Design and their application for Combinational and Sequential Circuits.
- Familiarize with Anti-Fuse Programmed FPGAs.
- Apply knowledge of this subject for various design applications.

UNIT - I		Lecture Hrs:

Introduction to Programmable Logic Devices: 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	Lecture Hrs:

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		Lecture Hrs:

SRAM Programmable FPGAs: Introduction, Programming Technology, Device Architecture, the Xilinx XC2000, XC3000 and XC4000 Architectures.

UNIT - IV		Lecture Hrs:

Anti-Fuse Programmed FPGAs: Introduction, Programming Technology, Device Architecture, The Actel ACT1, ACT2 and ACT3 Architectures.

UNIT - V		Lecture Hrs:

Design Applications: 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

Textbooks:

1. Field Programmable Gate Array Technology - Stephen M. Trimberger, Springer International Edition.
2. Digital Systems Design - Charles H. Roth Jr, LizyKurian John, Cengage Learning.

Reference Books:

1. Field Programmable Gate Arrays-John V.Oldfield, Richard C.Dorf, Wiley India.
2. Digital Design Using Field Programmable Gate Arrays - Pak K. Chan/SamihaMourad, Pearson Low Price Edition.
3. Digital Systems Design with FPGAs and CPLDs-Ian Grout, Elsevier,Newnes.
4. FPGA based System Design-Wayne Wolf, Prentice Hall Modern Semiconductor Design Series.

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COMMON COURSE STRUCTURE & SYLLABI

Course Code	ASIC DESIGN	L	T	P	C
21D57104c		3	0	0	3
	Semester	I			

Course Objectives:

- To understand different types of ASICs and their libraries.
- To understand about programmable ASICs, I/O modules and their interconnects.
- To familiarize different methods of software ASIC design their simulation, testing and construction of ASICs.

Course Outcomes (CO): Student will be able to

- Understand different types of ASICs and their libraries.
- Understand about programmable ASICs, I/O modules and their interconnects.
- Familiarize different methods of software ASIC design their simulation, testing and construction of ASICs.

UNIT - I Lecture Hrs:

Introduction to ASICs: Types of ASICs, Design Flow, Case Study, Economics of ASICs, ASIC Cell Libraries, Transistors as resistors, Transistor Parasitic Capacitance, Logical Effort, Library Cell Design, Library Architecture, Gate-Array Design, Standard Cell Design, Data Path Cell Design.

UNIT - II Lecture Hrs:

Programmable ASICs and Programmable ASIC Logic Cells: The Anti fuse, Static Ram, EPROM and EEPROM Technology, Practical Issues, Specifications, PREDP Benchmarks, FPGA Economics, Actel ACT, Xilinx LCA, Altera Flex, Altera Max.

UNIT - III Lecture Hrs:

I/O Cells and Interconnects & Programmable ASIC Design Software: DC Output, AC Output, DC input, AC input, Clock input, Power input, Xilinx I/O block, Other I/O Cells, Actel ACT, Xilinx LCA, Xilinx EPLD, Altera Max 5000 and 7000, Altera Max 9000, Altera FLEX, Design Systems, Logic Synthesis, The Half gate ASIC.

UNIT - IV Lecture Hrs:

Low Level Design Entry and Logic Synthesis: Schematic Entry, Low level Design Languages, PLA Tools, EDIF, A logic synthesis example, A Comparator/MUX, Inside a Logic Synthesizer, Synthesis of Viterbi Decoder, Verilog and Logic synthesis, VHDL and Logic Synthesis, Finite State Machine Synthesis, Memory Synthesis, The Engine Controller, Performance Driven Synthesis, Optimization of the viterbi decoder.

UNIT - V Lecture Hrs:

Simulation, Test and ASIC Construction: Types of Simulation, The Comparator/MUX Example, Logic Systems, How Logic Simulation Works, Cell Models, Delay Models, Static Timing Analysis, Formal Verification, Switch Level Simulation, Transistor Level Simulation, The importance of test, Boundary Scan Test, Faults, Faults Simulation, Automatic Test Pattern Generator, Scan Test, Built in Self-Test, A simple test Example, Physical Design, CAD Tools, System Partitioning, Estimating ASIC Size, Power Dissipation, FPGA Partitioning, Partitioning Methods

Textbooks:

1. Michael John Sebastian Smith, "Application Specific Integrated Circuits", Pearson Education, 2003.
2. L.J.Herbst, "Integrated Circuit Engineering", Oxford Science Publications, 1996.

Reference Books:

1. HimanshuBhatnagar, "Advanced ASIC Chip Synthesis using Synopsis Design Compiler", 2nd Edition, Kluwer Academic, 2001.

Course Code	CMOS ANALOG IC DESIGN LAB	L	T	P	C
21D57105		0	0	4	2
	Semester	I			

Course Objectives:

- To explain the VLSI Design Methodologies using VLSI design tool.
- To grasp the significance of various CMOS analog circuits in full-custom IC Design flow
- To explain the Physical Verification in Layout Design
- To fully appreciate the design and analyze of analog and mixed signal simulation
- To grasp the Significance of Pre-Layout Simulation and Post-Layout Simulation

Course Outcomes (CO):

- Explain the VLSI Design Methodologies using VLSI design tool.
- Grasp the significance of various CMOS analog circuits in full-custom IC Design flow
- Explain the Physical Verification in Layout Design
- Fully appreciate the design and analyze of analog and mixed signal simulation
- Grasp the Significance of Pre-Layout Simulation and Post-Layout Simulation

List of Experiments:

- The students are required to design and implement any **TEN** Experiments using CMOS 130nm Technology.
- The students are required to implement LAYOUTS of any **SIX** Experiments using CMOS 130nm Technology and Compare the results with Pre-Layout Simulation.

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. Operational Amplifier
10. Sample and Hold Circuit
11. Direct-conversion ADC
12. R-2R Ladder Type DAC

Lab Requirements:

Software:

Mentor Graphics – Pyxis Schematic, IC Station, Calibre, ELDO Simulator

Hardware:

Personal Computer with necessary peripherals, configuration and operating System.

Course Code	CMOS DIGITAL IC DESIGN LAB	L	T	P	C
21D57106		0	0	4	2
	Semester	I			

Course Objectives:

- To explain the VLSI Design Methodologies using any VLSI design tool.
- To grasp the significance of various design logic Circuits in full-custom IC Design.
- To explain the Physical Verification in Layout Extraction.
- To fully appreciate the design and analyze of CMOS Digital Circuits.
- To grasp the Significance of Pre-Layout Simulation and Post-Layout Simulation.

Course Outcomes (CO):

- Explain the VLSI Design Methodologies using any VLSI design tool.
- Grasp the significance of various design logic Circuits in full-custom IC Design.
- Explain the Physical Verification in Layout Extraction.
- Fully appreciate the design and analyze of CMOS Digital Circuits.

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

List of Experiments:

The students are required to design and implement the Circuit and Layout of any **TEN** Experiments using CMOS 130nm 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.

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M.TECH. IN VLSI/VLSI DESIGN/VLSI YSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

Course Code	RESEARCH METHODOLOGY AND IPR	L	T	P	C
21DRM101		2	0	0	2
	Semester			I	

Course Objectives:

- Identify an appropriate research problem in their interesting domain.
- Understand ethical issues understand the Preparation of a research project thesis report.
- Understand the Preparation of a research project thesis report
- Understand the law of patent and copyrights.
- Understand the Adequate knowledge on IPR

Course Outcomes (CO): Student will be able to

- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT - I		Lecture Hrs:

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, scope, and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT - II		Lecture Hrs:

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT - III		Lecture Hrs:

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT - IV		Lecture Hrs:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT - V		

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Textbooks:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

Reference Books:

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Asimov, "Introduction to Design", Prentice Hall, 1962.

6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.

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M.TECH. IN VLSI/VLSI DESIGN/VLSI YSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

Course Code	CMOS MIXED SIGNAL IC DESIGN	L	T	P	C
21D57201		3	0	0	3
	Semester	II			

Course Objectives:

- To demonstrate first order filter with least interference
- To extend the concept of phase locked loop for designing PLL application with minimum jitter by considering non ideal effects.
- To design different A/D, D/A, modulators, demodulators and different filter for real time applications

Course Outcomes (CO): Student will be able to

- Demonstrate first order filter with least interference
- Extend the concept of phase locked loop for designing PLL application with minimum jitter by considering non ideal effects.
- Design different A/D, D/A, modulators, demodulators and different filter for real time applications

UNIT - I Lecture Hrs:

Switched Capacitor Circuits: Introduction to Switched Capacitor circuits- basic building blocks, Operation and Analysis, Non-ideal effects in switched capacitor circuits, Switched capacitor integrators, first order filters, Switch sharing, biquad filters.

UNIT – II Lecture Hrs:

Phased Lock Loop (PLL) : Basic PLL topology, Dynamics of simple PLL, Charge pump PLLs-Lock acquisition, Phase/Frequency detector and charge pump, Basic charge pump PLL, Non-ideal effects in PLLs- PFD/CP non-idealities, Jitter in PLLs, Delay locked loops, applications

UNIT - III Lecture Hrs:

Data Converter: Fundamentals DC and dynamic specifications, Quantization noise, Nyquist rate D/A converters- Decoder based converters, Binary-Scaled converters, Thermometer-code converters, Hybrid converters

UNIT - IV Lecture Hrs:

A to D Converters: Nyquist Rate A/D Converters Successive approximation converters, Flash converter, Two-step A/D converters, Interpolating A/D converters, Folding A/D converters, Pipelined A/D converters, Sigma Delta A/D coverters, Time- interleaved converters.

UNIT - V Lecture Hrs:

Oversampling Converters: Noise shaping modulators, Decimating filters and interpolating filters, Higher order modulators, Delta sigma modulators with multi bit quantizers, Delta sigma D/A

Textbooks:

1. Design of Analog CMOS Integrated Circuits- BehzadRazavi, TMH Edition, 2002
2. CMOS Analog Circuit Design - Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.
3. Analog Integrated Circuit Design- David A. Johns, Ken Martin, Wiley Student Edition, 2013

Reference Books:

1. CMOS Integrated Analog-to- Digital and Digital-to-Analog converters- Rudy Van De Plassche, Kluwer Academic Publishers, 2003
2.Understanding Delta-Sigma Data converters-Richard Schreier, Wiley Inter science, 2005.
3. CMOS Mixed-Signal Circuit Design - R. Jacob Baker, Wiley Interscience,2009

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M.TECH. IN VLSI/VLSI DESIGN/VLSI YSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

Course Code	PHYSICAL DESIGN AUTOMATION	L	T	P	C
21D57202		3	0	0	3
	Semester	II			

Course Objectives:

- To understand relation between automation algorithms and constraints posed by VLSI technology.
- To adopt algorithms to meet critical design parameters.
- To design area efficient logics by employing different routing algorithms and shape functions.
- To simulate and synthesis different combinational and sequential logics.

Course Outcomes (CO): Student will be able to

- Understand relation between automation algorithms and constraints posed by VLSI technology.
- Adopt algorithms to meet critical design parameters.
- Design area efficient logics by employing different routing algorithms and shape functions.
- Simulate and synthesis different combinational and sequential logics.

UNIT - I		Lecture Hrs:

VLSI Design Automation Tools: Algorithms and system design, Structural and logic design, Transistor level design, Layout design, Verification methods, Design management tools.

UNIT - II		Lecture Hrs:

Layout: 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		Lecture Hrs:

Floor planning and routing: Floor planning concepts, Shape functions and floor planning sizing, Local routing, Area routing, Channel routing, global routing and its algorithms.

UNIT - IV		Lecture Hrs:

Simulation and Logic Synthesis: 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		Lecture Hrs:

High-Level Synthesis: Hardware model for high level synthesis, internal representation of input algorithms, Allocation, assignment and scheduling, scheduling algorithms, Aspects of assignment, High level transformations.

Textbooks:

1. S.H. Gerez, Algorithms for VLSI Design Automation, John Wiley, 1998.
2. N.A. Sherwani, Algorithms for VLSI Physical Design Automation, (3/e), Kluwer, 1999.

Reference Books:

1. S.M. Sait,H.Youssef, VLSI Physical Design Automation, World scientific, 1999.
2. M.Sarrafzadeh, Introduction to VLSI Physical Design, McGraw Hill (IE), 1996

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M.TECH. IN VLSI/VLSI DESIGN/VLSI YSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

Course Code	SoC TESTING AND VERIFICATION	L	T	P	C
21D57203a		3	0	0	3
	Semester	II			

Course Objectives:

- To understand the concepts of faults and testing in SoC
- To implement the faults using simulation tools
- To analyze BIST systems

Course Outcomes (CO): Student will be able to

- Understand the concepts of faults and testing in SoC
- Implement the faults using simulation tools
- Analyze BIST systems

UNIT - I		Lecture Hrs:

Introduction to Testing: Testing Philosophy, Role of Testing, Digital and Analog VLSI Testing, VLSI Technology Trends affecting Testing, Types of Testing, Fault Modeling: Defects, Errors and Faults, Functional Versus Structural Testing, Levels of Fault Models, Single Stuck-at Fault.

UNIT - II		Lecture Hrs:

Logic and Fault Simulation: Simulation for Design Verification and Test Evaluation, Modeling Circuits for Simulation, Algorithms for True-value Simulation, Algorithms for Fault Simulation.

UNIT - III		Lecture Hrs:

Testability Measures: SCOAP Controllability and Observablity, High Level Testability Measures, Digital DFT and Scan Design: Ad-Hoc DFT Methods, Scan Design, Partial-Scan Design, Variations of Scan.

UNIT - IV		Lecture Hrs:

Built-In Self-Test: The Economic Case for BIST, Random Logic BIST: Definitions, BIST Process, Pattern Generation, Response Compaction, Built-In Logic Block Observers, Test-Per-Clock, Test-Per-Scan BIST Systems, Circular Self Test Path System, Memory BIST, Delay Fault BIST.

UNIT - V		Lecture Hrs:

Boundary Scan Standard: Motivation, System Configuration with Boundary Scan: TAP Controller and Port, Boundary Scan Test Instructions, Pin Constraints of the Standard, Boundary Scan Description Language: BDSL Description Components, Pin Descriptions.

Textbooks:

1. M.L. Bushnell, V. D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed Signal VLSI Circuits", Kluwer Academic Pulishers.
2. M. Abramovici, M.A.Breuer and A.D Friedman, "Digital Systems and Testable Design", Jaico Publishing House.

Reference Books:

1. P.K. Lala, "Digital Circuits Testing and Testability", Academic Press.

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M.TECH. IN VLSI/VLSI DESIGN/VLSI YSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

Course Code	SEMICONDUCTOR MEMORY DESIGN AND TESTING	L	T	P	C
21D57203b		3	0	0	3
	Semester	II			

Course Objectives:

- To understand different types of memories, their architectural and different packing techniques of memories.
- To build fault models for memory testing.
- To analyze different parameters that lead malfunctioning of memories.
- To design reliable memories with efficient architecture to improve processes times and power.

Course Outcomes (CO): Student will be able to

- Get complete knowledge regarding different types of memories, their architectural and different packing techniques of memories.
- Build fault models for memory testing.
- Analyze different parameters that lead malfunctioning of memories.
- Design reliable memories with efficient architecture to improve processes times and power.

UNIT - I Lecture Hrs:

Random Access Memory Technologies :SRAM – SRAM Cell structures, MOS SRAM Architecture, MOS SRAM cell and peripheral circuit operation, Bipolar SRAM technologies, SOI technology, Advanced SRAM architectures and technologies, Application specific SRAMs, DRAM – DRAM technology development, CMOS DRAM, DRAM cell theory and advanced cell structures, BICMOS DRAM, soft error failure in DRAM, Advanced DRAM design and architecture, Application specific DRAM.

UNIT - II Lecture Hrs:

Non-volatile Memories: Masked ROMs, High density ROM, PROM, Bipolar ROM, CMOS PROMS, EPROM, Floating gate EPROM cell, One time programmable EPROM, EEPROM, EEPROM technology and architecture, Non-volatile SRAM, Flash Memories (EPROM or EEPROM), advanced Flash memory architecture

UNIT - III Lecture Hrs:

Memory Fault Modeling Testing and Memory Design for Testability and Fault Tolerance : RAM fault modeling, Electrical testing, Pseudo Random testing, Megabit DRAM Testing, non-volatile memory modeling and testing, IDDQ fault modeling and testing, Application specific memory testing, RAM fault modeling, BIST techniques for memory.

UNIT - IV Lecture Hrs:

Semiconductor Memory Reliability and Radiation Effects: General reliability issues RAM failure modes and mechanism, Non-volatile memory reliability, reliability modeling and failure rate prediction, Design for Reliability, Reliability Test Structures, Reliability Screening and qualification, Radiation effects, Single Event Phenomenon (SEP), Radiation Hardening techniques, Radiation Hardening Process and Design Issues, Radiation Hardened Memory characteristics, Radiation Hardness Assurance and Testing, Radiation Dosimetry, Water Level Radiation Testing and Test structures.

UNIT - V Lecture Hrs:

Advanced Memory Technologies and High-density Memory Packing Technologies
Ferroelectric RAMs (FRAMs), GaAs FRAMs, Analog memories, magneto resistive RAMs (MRAMs), Experimental memory devices, Memory Hybrids and MCMs (2D), Memory Stacks and MCMs (3D), Memory MCM testing and reliability issues, Memory cards, High Density Memory

Packaging Future Directions.
Textbooks:
1. Semiconductor Memories Technology – Ashok K. Sharma, 2002, Wiley. 2. Advanced Semiconductor Memories – Architecture, Design and Applications - Ashok K. Sharma, 2002, Wiley.
Reference Books:
1. Modern Semiconductor Devices for Integrated Circuits – Chenming C Hu, First Edition. Prentice all.

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M.TECH. IN VLSI/VLSI DESIGN/VLSI YSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

Course Code	MEMS SYSTEM DESIGN	L	T	P	C
21D57203c		3	0	0	3
	Semester	II			

Course Objectives:

- To understand the basic concepts of MEMS technology and working of MEMS devices.
- To understand and select different materials for current MEMS devices and competing technologies for future applications.
- To understand the concepts of fabrication process of MEMS, Design and Packaging Methodology.
- To analyze the various fabrication techniques in the manufacturing of MEMS Devices.

Course Outcomes (CO): Student will be able to

- Understand the basic concepts of MEMS technology and working of MEMS devices.
- Understand and select different materials for current MEMS devices and competing technologies for future applications.
- Understand the concepts of fabrication process of MEMS, Design and Packaging Methodology.
- Analyze the various fabrication techniques in the manufacturing of MEMS Devices.

UNIT - I		Lecture Hrs:

Introduction to MEMS: Introduction to MEMS & Real world Sensor/Actuator examples (DMD, Air-bag, pressure sensors).MEMS Sensors in Internet of Things (IoT), Bio-Medical Applications

UNIT - II		Lecture Hrs:

MEMS Materials and Their Properties: Materials (eg. Si, SiO2, SiN, Cr, Au, Ti, SU8, PMMA, Pt); Important properties: Young modulus, Poisson's ratio, density, piezo-resistive coefficients, TCR, Thermal Conductivity, Material Structure. Understanding Selection of materials based on applications.

UNIT - III		Lecture Hrs:

MEMS Fab Processes – 1: Understanding MEMS Processes & Process parameters for: Cleaning, Growth &Deposition, Ion Implantation & Diffusion, Annealing, Lithography. Understanding selection of Fab processes based on Applications.

UNIT - IV		Lecture Hrs:

MEMS Fab Processes – 2: Understanding MEMS Processes & Process parameters for: Wet & Dry etching, Bulk& Surface Micromachining, Die, Wire& Wafer Bonding, Dicing, Packaging. Understanding selection of Fab processes based on Applications.

UNIT - V		Lecture Hrs:

MEMS Devices: Architecture, working and basic quantitative behaviour of Cantilevers, Micro heaters, Accelerometers, Pressure Sensors, Micro mirrors in DMD, Inkjet printer-head. Understanding steps involved in Fabricating above devices.

Textbooks:

1. An Introduction to Micro electromechanical Systems Engineering; 2nd Edition by N.Maluf, K Williams; Publisher: Artech House Inc
2. Practical MEMS - by Ville Kaajakari; Publisher: Small Gear Publishing
3. Micro system Design - by S. Senturia; Publisher: Springer

Reference Books:

1.Analysis and Design Principles of MEMS Devices –Minhang Bao; Publisher: Elsevier Science.

2. Fundamentals of Micro fabrication - by M. Madou; Publisher:CRC Press; 2ndedition
3.Micro Electro Mechanical System Design - by J. Allen; Publisher: CRC Press
4.Micro machined Transducers Sourcebook - by G. Kovacs; Publisher: McGraw-Hill

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M.TECH. IN VLSI/VLSI DESIGN/VLSI YSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

Course Code	LOW POWER VLSI DESIGN	L	T	P	C
21D57204a		3	0	0	3
	Semester	II			

Course Objectives:

- To understand the concepts of velocity saturation, Impact Ionization and Hot Electron Effect
- To implement Low power design approaches for system level and circuit level measures.
- To design low power adders, multipliers and memories for efficient design of systems.

Course Outcomes (CO): Student will be able to

- Understand the concepts of velocity saturation, Impact Ionization and Hot Electron Effect
- Implement Low power design approaches for system level and circuit level measures.
- Design low power adders, multipliers and memories for efficient design of systems.

UNIT - I Lecture Hrs:

Fundamentals: 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 Lecture Hrs:

Low-Power Design Approaches: 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 Lecture Hrs:

Low-Voltage Low-Power Adders: 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 Lecture Hrs:

Low-Voltage Low-Power Multipliers: Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.

UNIT - V Lecture Hrs:

Low-Voltage Low-Power Memories: Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

Textbooks:

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

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

Reference Books:

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

2.Low Power CMOS Design – AnanthaChandrakasan, IEEE Press/Wiley International, 1998.

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

Course Code	IOT AND ITS APPLICATIONS	L	T	P	C
21D57204b		3	0	0	3
	Semester	II			

Course Objectives:

- To apply the Knowledge in IOT Technologies and Data management.
- To determine the values chains Perspective of M2M to IOT.
- To implement the state of the Architecture of an IOT.
- To compare IOT Applications in Industrial & real world.
- To demonstrate knowledge and understand the security and ethical issues of an IOT.

Course Outcomes (CO): Student will be able to

- Apply the Knowledge in IOT Technologies and Data management.
- Determine the values chains Perspective of M2M to IOT.
- Implement the state of the Architecture of an IOT.
- Compare IOT Applications in Industrial & real world.
- Demonstrate knowledge and understand the security and ethical issues of an IOT.

UNIT - I | Lecture Hrs:

Fundamentals of IoT: 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 | Lecture Hrs:

IoT Protocols: 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 | Lecture Hrs:

Design and Development: 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 | Lecture Hrs:

Data Analytics and Supporting Services: 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 | Lecture Hrs:

Case Studies/Industrial Applications: 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).

Textbooks:

1. 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.

2. Internet of Things – A hands-on approach, ArshdeepBahga, Vijay Madisetti, Universities Press,2015
Reference Books:
1. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012 (for Unit 2). 2. “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. 3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer, 2011.

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M.TECH. IN VLSI/VLSI DESIGN/VLSI YSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

Course Code	**VLSI SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
21D57204c		**3**	**0**	**0**	**3**
	Semester	**II**			

Course Objectives:

- To study the existing architectures suitable for VLSI.
- To understand the concepts of folding and unfolding algorithms and applications.
- To design new architectures suitable for VLSI.
- To implement fast convolution algorithms.

Course Outcomes (CO): Student will be able to

- Study the existing architectures suitable for VLSI.
- Understand the concepts of folding and unfolding algorithms and applications.
- Design new architectures suitable for VLSI.
- Implement fast convolution algorithms.

UNIT - I		Lecture Hrs:

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		Lecture Hrs:

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

UNIT - III		Lecture Hrs:

Systolic Architecture Design: 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		Lecture Hrs:

Fast Convolution: Introduction – Cook - Toom Algorithm – Winogard algorithm – Iterated Convolution – Cyclic Convolution – Design of Fast Convolution algorithm by Inspection

UNIT - V		Lecture Hrs:

Low Power Design: 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

Textbooks:

1. Keshab K. Parthi, VLSI Digital Signal Processing- System Design and Implementation, Wiley Inter Science, 1998.
2. Kung S. Y, H. J. While House, T. Kailath ,VLSI and Modern Signal processing , Prentice Hall, 1985.

Reference Books

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

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M.TECH. IN VLSI/VLSI DESIGN/VLSI YSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

Course Code	CMOS MIXED SIGNAL IC DESIGN LAB	L	T	P	C
21D57205		0	0	4	2
	Semester	II			

Course Objectives:

- To design and simulate op-amp for given specifications
- To design and simulate data converter for given specifications
- To design and simulate PLL and VCO for given specifications
- To understand the Significance of Pre-Layout Simulation and Post-Layout Simulation.

Course Outcomes (CO):

- Design and simulate op-amp for given specifications
- Design and simulate data converter for given specifications
- Design and simulate PLL and VCO for given specifications
- Understand the Significance of Pre-Layout Simulation and Post-Layout Simulation.

List of Experiments:

The students are required to design and implement the Circuit and Layout of the following Experiments using CMOS 130nm Technology.

Cycle 1:

1) Fully compensated op-amp with resistor and miller compensation
2) High speed comparator design
   a. Two stage cross coupled clamped comparator
   b. Strobed Flip-flop
3) Data converter

Cycle 2:

1) Switched capacitor circuits
   a. Parasitic sensitive integrator
   b. Parasitic insensitive integrator
2) Design of PLL
3) Design of VCO
4) Band gap reference circuit
5) Layouts of All the circuits Designed and Simulated

Software:

Mentor Graphics/ Cadence/ Tanner/Industry Equivalent Standard Software Tools

Hardware:

Personal Computer with necessary peripherals, configuration and operating System.

References:

1. David A johns, Ken Martin, Analog Integrated Circuit Design, Wiley, 2008.
2. R. Gregorian and G.C Ternes, Analog MOS Integrated Circuits for Signal Processing, Wiley,1986.
3. Roubik Gregorian, Introduction to CMOS OpAmp and Comparators, Wiley, 1999.
4. Alan Hastlings, The art of Analog Layout, Wiley, 2005.

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M.TECH. IN VLSI/VLSI DESIGN/VLSI YSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

Course Code	PHYSICAL DESIGN AUTOMATION LAB	L	T	P	C
21D57206		0	0	4	2
	Semester	II			

Course Objectives:

- To learn the implementation of different Physical Design Automation algorithms
- To implement different graph algorithms
- To implement different partitioning algorithms
- To implement different floor planning algorithms
- To implement different routing algorithms

Course Outcomes (CO):

- Learn the implementation of different Physical Design Automation algorithms
- Implement different graph algorithms
- Implement different partitioning algorithms
- Implement different floor planning algorithms
- Implement different routing algorithms

List of Experiments:

Cycle 1:

1) Graph algorithms
   a) Graph search algorithms
      i. Depth first search
      ii. Breadth first search
   b) Spanning tree algorithm
      i. Kruskal"s algorithm
   c) Shortest path algorithm
      i. Dijkstra algorithm
      ii. Floyd- Warshall algorithm
   d) Steiner tree algorithm
2) Computational geometry algorithm
   a) Line sweep method
   b) Extended line sweep method

Cycle 2:

3) Partitioning algorithms
   a) Group migration algorithms
      I. Kernighan –Lin algorithm
      II. Extensions of Kernighan-Lin algorithm
         i) Fiduccias –Mattheyses algorithm
         ii) Goldberg and Burstein algorithm
   b) Simulated annealing and evolution algorithms
      i. Simulated annealing algorithm
      ii. Simulated evolution algorithm
   III) Metric allocation method

4) Floor planning algorithms
      i) Constraint based methods
      ii) Integer programming based methods
      iii) Rectangular dualization based methods
      iv) Hierarchical tree based methods

v) Simulated evolution algorithms
vi) Time driven Floor planning algorithms

5) Routing algorithms
I) Two terminal algorithms
a) Maze routing algorithms
i)Lee‟s algorithm
ii) Soukup‟s algorithm
iii) Hadlock algorithm
b) Line-Probe algorithm
c) Shortest path based algorithm
II) Multi terminal algorithm
a) Stenier tree based algorithm
i) SMST algorithm
ii) Z-RST algorithm

Software required: C/C++ Programming Language /Relevant software

Text Books:

1) Naveed Shervani, Algorithms for Physical Design Automation, 3rd Edition, Kluwer Academic,1998.
2) Charles J Alpert, Dinesh P Mehta, Sachin S. Sapatnekar, Handbook of Algorithms for Physical Design Automation, CRC Press,2008.

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M.TECH. IN VLSI/VLSI DESIGN/VLSI YSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

Course Code	**BICMOS TECHNOLOGY AND APPLICATIONS**	**L**	**T**	**P**	**C**
21D57301a		**3**	**0**	**0**	**3**
	Semester	**III**			

Course Objectives:

- To demonstrate in-depth knowledge in BiCMOS Technology.
- To analyze complex engineering problems critically for conducting research in BiCMOS Technology.
- To solve engineering problems with wide range of solutions in Radio Frequency Integrated circuits.
- To realize different digital circuits using BiCMOS Technology

Course Outcomes (CO): Student will be able to

- Demonstrate in-depth knowledge in BiCMOS Technology.
- Analyze complex engineering problems critically for conducting research in BiCMOS Technology.
- Solve engineering problems with wide range of solutions in Radio Frequency Integrated circuits.
- Realize different digital circuits using BiCMOS Technology

UNIT - I Lecture Hrs:

BiCMOS Process Technology: CMOS Process Technology, Bipolar Process Technology, Isolation in CMOS and Bipolar Technologies, BiCMOS Technology, BiCMOS Design Rules.

UNIT - II Lecture Hrs:

Device Design Considerations: Design Considerations for MOSFET's, Design Considerations for Bipolar Transistors, BiCMOS Device Design Considerations.
BiCMOS Device Scaling: MOS Device Scaling, Bipolar Device Scaling.

UNIT - III Lecture Hrs:

Device Modeling: Modeling of the MOS Transistor: MOSFET Structure and Operation, SPICE Models of the MOS Transistor,Analytical Model for Short-Channel MOS Devices.
Modeling of the Bipolar Transistor: BJT Structure and Operation, Ebers-Moll Model, Bipolar Models in SPICE.

UNIT - IV Lecture Hrs:

BiCMOS DigitalIntegrated Circuits: BiMOS Totem-Pole Inveter: DC Characteristics, Transient Analysis, Delay Dependence on the Device Parameters, BiCMOS Circuit Design, Comparing CMOS and BiCMOS Inverters Speed, BiCMOS Gates.

UNIT - V Lecture Hrs:

BiCMOS Digital Circuit Applications: Adders, Multiplier, Random Access Memory, Programmable Logic Arrays, BiCMOS Logic Cells, BiCMOS Gate Arrays.

Textbooks:

1.Sherif H.K. Embabi, AbdellatifBellaouar& Mohamed I. Elmasry “Digital BiCMOS Integrated Circuit Design” Springer Science+ BusÎness Media, LLC.
2.A L ALVAREZ, BICMOS Technology & Applications, Kluwer Academic Publishers.

Reference Books:

1.Kiat-Seng yeo, Samir S. Rofail, Wang-Ling Goh, CMOS/BiCMOS ULSI, Pearson Education.
2.James C. Daly, Denis P. Galipeau, Analog BiCMOS Design: Practices & Pitfalls, CRC Press
3.KlaasJan de Langen, Johan Huijsing, Compact Low-Voltage and High-Speed CMOS, BiCMOS and Bipolar Operational Amplifiers, Springer Science

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M.TECH. IN VLSI/VLSI DESIGN/VLSI YSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

Course Code	OPTIMIZATION TECHNIQUES AND APPLICATIONS IN VLSI DESIGN	L	T	P	C
21D57301b		3	0	0	3
	Semester	III			

Course Objectives:

- To understand basics of statistical modeling
- To analyze performance of CMOS circuits with respect to power, area and speed
- To acquire complete knowledge regarding the various algorithms used for optimization of power and area

Course Outcomes (CO): Student will be able to

- Understand basics of statistical modeling
- Analyze performance of CMOS circuits with respect to power, area and speed
- Acquire complete knowledge regarding the various algorithms used for optimization of power and area

UNIT - I		Lecture Hrs:

Statistical Modeling: Modeling sources of variations, Monte Carlo techniques, Process variation modeling-Pelgrom's model, Principle component based modeling, Quad tree based modeling, Performance modeling- Response surface methodology, delay modeling, interconnect delay models.

UNIT - II		Lecture Hrs:

Statistical Performance, Power and Yield Analysis: Statistical timing analysis, parameter space techniques, Bayesian networks Leakage models, High level statistical analysis, Gate level statistical analysis, dynamic power, leakage power, temperature and power supply variations, High level yield estimation and gate level yield estimation.

UNIT - III		Lecture Hrs:

Convex Optimization: Convex sets, convex functions, geometric programming, trade-off and sensitivity analysis, Generalized geometric programming, geometric programming applied to digital circuit gate sizing, Floorplanning, wiresizing, Approximation andfitting-Monomial fitting, Maxmonomial fitting, Polynomial fitting.

UNIT - IV		Lecture Hrs:

Genetic Algorithm: Introduction, GA Technology-Steady State Algorithm-Fitness Scaling-Inversion GA for VLSI Design, Layout and Test automation- partitioning-automatic placement, routing technology, mappingfor FPGA-Automatic testgeneration-Partitioning algorithm Taxonomy-Multi-way Partitioning Hybrid genetic-encoding-local improvement-WDFR Comparison of CAS-Standard cell placement GASP algorithm-unified algorithm.

UNIT - V		Lecture Hrs:

GA Routing Proceduresand Power Estimation: Global routing-FPGA technology mapping-circuit generation-test generation in a GA frame work-test generation procedures, Power estimation-application ofGA Standard cellplacement – GAforATG-problem encoding-fitness function-GA Vs Conventional algorithm.

Textbooks:

1.Statistical Analysis and Optimization for VLSI: Timing and Power –Ashish Srivastava, DennisSylvester, David Blaauw, Springer, 2005.
2. Genetic Algorithm for VLSI Design, Layout and Test Automation -PinakiMazumder, E.Mrudnick, Prentice Hall,1998.

Reference Books:

1.Convex Optimization- Stephen Boyd, LievenVandenberghe, Cambridge University Press,2004

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M.TECH. IN VLSI/VLSI DESIGN/VLSI YSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

Course Code	SoC ARCHITECTURE	L	T	P	C
21D06203a		3	0	0	3
	Semester	III			

Course Objectives:

- To understand the basics related to SoC architecture and different approaches related to SoC Design.
- To select an appropriate robust processor for SoC Design
- To select an appropriate memory for SoC Design.
- To realize real time case studies

Course Outcomes (CO): Student will be able to

- Understand the basics related to SoC architecture and different approaches related to SoC Design.
- Select an appropriated robust processor for SoC Design
- Select an appropriate memory for SoC Design.
- Realize real time case studies

UNIT - I Lecture Hrs:

Introduction to the System Approach: 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 Lecture Hrs:

Processors: 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 Lecture Hrs:

Memory Design for SOC: 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 Lecture Hrs:

Interconnect, Customization and Configurability: 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 Lecture Hrs:

Application Studies / Case Studies: SOC Design approach; AES-algorithms, Design and evaluation; Image compression–JPEG compression.

Textbooks:

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

Reference Books:

1. Design of System on a Chip: Devices and Components – Ricardo Reis, 1st Ed., 2004, Springer
2.Co-Verification of Hardware and Software for ARM System on Chip Design (EmbeddedTechnology) – Jason Andrews – Newnes, BK and CDROM.
3.System on Chip Verification – Methodologies and Techniques –PrakashRashinkar, PeterPaterson and Leena Singh L, 2001, Kluwer Academic Publishers

AUDIT COURSE-I

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M.TECH. IN VLSI/VLSI DESIGN/VLSI YSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

Course Code	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
21DAC101a		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- Understand the essentials of writing skills and their level of readability
- Learn about what to write in each section
- Ensure qualitative presentation with linguistic accuracy

Course Outcomes (CO): Student will be able to

- Understand the significance of writing skills and the level of readability
- Analyze and write title, abstract, different sections in research paper
- Develop the skills needed while writing a research paper

UNIT - I		Lecture Hrs:10

1Overview of a Research Paper- Planning and Preparation- Word Order- Useful Phrases - Breaking up Long Sentences-Structuring Paragraphs and Sentences-Being Concise and Removing Redundancy -Avoiding Ambiguity

UNIT - II		Lecture Hrs:10

Essential Components of a Research Paper- Abstracts- Building Hypothesis-Research Problem - Highlight Findings- Hedging and Criticizing, Paraphrasing and Plagiarism, Cauterization

UNIT - III		Lecture Hrs:10

Introducing Review of the Literature – Methodology - Analysis of the Data-Findings - Discussion-Conclusions-Recommendations.

UNIT - IV		Lecture Hrs:9

Key skills needed for writing a Title, Abstract, and Introduction

UNIT - V		Lecture Hrs:9

Appropriate language to formulate Methodology, incorporate Results, put forth Arguments and draw Conclusions

Suggested Reading

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) Model Curriculum of Engineering & Technology PG Courses [Volume-I]
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

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M.TECH. IN VLSI/VLSI DESIGN/VLSI YSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

Course Code	DISASTER MANAGEMENT	L	T	P	C
21DAC101b		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- Learn to demonstrate critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluatedisasterriskreduction and humanitarian response policy and practice from Multiple perspectives.
- Developanunderstandingofstandardsofhumanitarianresponseandpracticalrelevanceinspecific types of disasters and conflict situations
- Criticallyunderstandthestrengthsandweaknessesofdisastermanagementapproaches,planningand programming in different countries, particularly their home country or the countries they work in

UNIT - I

Introduction:
Disaster:Definition,FactorsandSignificance;DifferenceBetweenHazardandDisaster;Naturaland Manmade Disasters: Difference, Nature, Types and Magnitude.

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:
Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes,Volcanisms,Cyclones,Tsunamis,Floods,DroughtsandFamines,Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT - III

Disaster Preparedness and Management:
Preparedness: Monitoring of Phenomena Triggering ADisasteror Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT - IV

Risk Assessment Disaster Risk:
Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. TechniquesofRiskAssessment,GlobalCo-OperationinRiskAssessmentand Warning, People's Participation in Risk Assessment. Strategies for Survival.

UNIT - V

Disaster Mitigation:
Meaning,ConceptandStrategiesofDisasterMitigation,EmergingTrendsInMitigation.Structural Mitigationand Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Suggested Reading

1. R.Nishith,SinghAK,"DisasterManagementinIndia:Perspectives,issuesandstrategies
2. "'New Royal book

Company..Sahni,PardeepEt.Al.(Eds.),"DisasterMitigationExperiencesAndReflections",PrenticeHall OfIndia, New Delhi. 3. GoelS.L.,DisasterAdministrationAndManagementTextAndCaseStudies",Deep&Deep Publication Pvt. Ltd., New Delhi

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M.TECH. IN VLSI/VLSI DESIGN/VLSI YSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

Course Code	**SANSKRITFOR TECHNICAL KNOWLEDGE**	**L**	**T**	**P**	**C**
21DAC101c		**2**	**0**	**0**	**0**
	Semester	**I**			

Course Objectives: This course will enable students:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- LearningofSanskrittodevelopthelogicinmathematics,science&othersubjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge
- Knowledge from ancientliterature

Course Outcomes (CO): Student will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science &technology can be understood
- Being a logical language will help to develop logic in students

UNIT - I

Alphabets in Sanskrit,

UNIT - II

Past/Present/Future Tense, Simple Sentences

UNIT - III

Order, Introduction of roots

UNIT - IV

Technical information about Sanskrit Literature

UNIT - V

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested Reading

1.“Abhyaspustakam” –Dr.Vishwas, Sanskrit-Bharti Publication, New Delhi
2.“Teach Yourself Sanskrit” Prathama Deeksha- VempatiKutumbshastri, RashtriyaSanskrit Sansthanam, New Delhi Publication
3.“India’s Glorious ScientificTradition” Suresh Soni, Ocean books (P) Ltd.,New Delhi

AUDIT COURSE-II

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M.TECH. IN VLSI/VLSI DESIGN/VLSI YSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

Course Code	PEDAGOGY STUDIES	L	T	P	C
21DAC201a		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

- Reviewexistingevidenceonthereviewtopictoinformprogrammedesignandpolicy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes (CO): Student will be able to

Students will be able to understand:

- Whatpedagogicalpracticesarebeingusedbyteachersinformalandinformalclassrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- Howcanteachereducation(curriculumandpracticum)andtheschoolcurriculumand guidance materials best support effective pedagogy?

UNIT - I

Introduction and Methodology: Aims and rationale, Policy back ground, Conceptual frame work and terminology Theories oflearning,Curriculum,Teachereducation.Conceptualframework,Research questions**.** Overview of methodology and Searching.

UNIT - II

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT - III

Evidence on theeffectivenessofpedagogicalpractices,Methodologyfortheindepthstage:quality assessmen t of included studies. How can teacher education (curriculumandpracticum) andthescho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of th body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT - IV

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacherandthecommunity.Curriculumandassessment,Barrierstolearning:limitedresourcesand large class sizes

UNIT - V

Researchgapsandfuturedirections: Researchdesign**,**Contexts**,**Pedagogy**,**Teachereducation**,** Curriculum and assessment**,** Dissemination and research impact.

Suggested Reading

1. AckersJ,HardmanF(2001)ClassroominteractioninKenyanprimaryschools,Compare, 31 (2): 245-261.
2. AgrawalM(2004)Curricularreforminschools:Theimportanceofevaluation,Journalof
3. Curriculum Studies, 36 (3): 361-379.

4. AkyeampongK(2003) Teacher training in Ghana - does it count? Multi-site teachereducation research project (MUSTER) country report 1. London: DFID.
5. Akyeampong K, LussierK, PryorJ, Westbrook J (2013)Improving teaching and learning of basic maths and reading in Africa: Does teacherpreparation count?International Journal Educational Development, 33 (3): 272–282.
6. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
   Chavan M (2003)ReadIndia: A mass scale, rapid, 'learning to read'campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

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M.TECH. IN VLSI/VLSI DESIGN/VLSI YSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

Course Code	**STRESSMANAGEMENT BY YOGA**	**L**	**T**	**P**	**C**
21DAC201b		**2**	**0**	**0**	**0**
	Semester	**II**			

Course Objectives: This course will enable students:

- To achieve overall health of body and mind
- To overcome stres

Course Outcomes (CO): Student will be able to

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT - I

Definitions of Eight parts of yog.(Ashtanga)

UNIT - II

Yam and Niyam.

UNIT - III

Do`sand Don’t’sin life.

i) Ahinsa,satya,astheya,bramhacharyaand aparigrahaii) Shaucha,santosh,tapa,swadhyay,ishwarpranidhan

UNIT - IV

Asan and Pranayam

UNIT - V

i)Variousyogposesand theirbenefitsformind &body

ii)Regularizationofbreathingtechniques and its effects-Types ofpranayam

Suggested Reading

1.‘Yogic Asanas forGroupTarining-Part-I”: Janardan SwamiYogabhyasiMandal, Nagpur
2.“Rajayogaor conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course Code	PERSONALITY DEVELOPMENT THROUGHLIFE ENLIGHTENMENTSKILLS	L	T	P	C
21DAC201c		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

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

Course Outcomes (CO): Student will be able to

- StudyofShrimad-Bhagwad-Geetawillhelpthestudentindevelopinghispersonalityand achieve the highest goal in life
- The person who has studied Geetawilllead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT - I

Neetisatakam- Holistic development of personality

Verses-19,20,21,22(wisdom)
Verses-29,31,32(pride &heroism)
Verses-26,28,63,65(virtue)

UNIT - II

Neetisatakam- Holistic development of personality

Verses-52,53,59(dont's)
Verses-71,73,75,78(do's)

UNIT - III

Approach to day to day work and duties.

ShrimadBhagwadGeeta:Chapter2-Verses41,47,48,
Chapter3-Verses13,21,27,35,Chapter6-Verses5,13,17,23,35,
Chapter18-Verses45,46,48.

UNIT - IV

Statements of basic knowledge.

ShrimadBhagwadGeeta:Chapter2-Verses 56,62,68
Chapter12 -Verses13,14,15,16,17,18
Personality of Rolemodel. Shrimad Bhagwad Geeta:

UNIT - V

Chapter2-Verses 17,Chapter3-Verses36,37,42,
Chapter4-Verses18,38,39
Chapter18– Verses37,38,63

Suggested Reading

1.“SrimadBhagavadGita”bySwamiSwarupanandaAdvaitaAshram(PublicationDepartment), Kolkata
2.Bhartrihari'sThree Satakam (Niti-sringar-vairagya) by P.Gopinath, RashtriyaSanskrit Sansthanam, New Delhi.

OPEN ELECTIVE

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M.TECH. IN VLSI/VLSI DESIGN/VLSI YSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

Course Code	INDUSTRIAL SAFETY	L	T	P	C
21DOE301b		3	0	0	3
	Semester	III			

Course Objectives:

- To know about Industrial safety programs and toxicology, Industrial laws , regulations and source models
- To understand about fire and explosion, preventive methods, relief and its sizing methods
- To analyse industrial hazards and its risk assessment.

Course Outcomes (CO): Student will be able to

- To list out important legislations related to health, Safety and Environment.
- To list out requirements mentioned in factories act for the prevention of accidents.
- To understand the health and welfare provisions given in factories act.

UNIT - I Lecture Hrs:

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT - II Lecture Hrs:

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT - III Lecture Hrs:

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working andapplications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT - IV Lecture Hrs:

Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT - V Lecture Hrs:

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Textbooks:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.

Reference Books:

1. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
2. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

COMMON COURSE STRUCTURE & SYLLABI

Course Code	BUSINESS ANALYTICS	L	T	P	C
21DOE301c		3	0	0	3
	Semester		III		

Course Objectives:

- The main objective of this course is to give the student a comprehensive understanding of business analytics methods.

Course Outcomes (CO): Student will be able to

- Students will demonstrate knowledge of data analytics.
- Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
- Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
- Students will demonstrate the ability to translate data into clear, actionable insights.

UNIT - I		Lecture Hrs:

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst.
Stakeholders: the project team, management, and the front line, Handling Stakeholder Conflicts.

UNIT - II		Lecture Hrs:

Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

UNIT - III		Lecture Hrs:

Forming Requirements: Overview of Requirements, Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

UNIT - IV		Lecture Hrs:

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements. Managing Requirements Assets: Change Control, Requirements Tools

UNIT - V		Lecture Hrs:

Recent Trands in: Embedded and colleborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

Textbooks:

1. Business Analysis by James Cadle et al.
2. Project Management: The Managerial Process by Erik Larson and, Clifford Gray

Reference Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

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ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN VLSI/VLSI DESIGN/VLSI YSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

Course Code	WASTE TO ENERGY	L	T	P	C
21DOE301e		3	0	0	3
	Semester	III			

Course Objectives:

- Introduce and explain energy from waste, classification and devices to convert waste to energy.
- To impart knowledge on biomass pyrolysis, gasification, combustion and conversion process.
- To educate on biogas properties ,bio energy system, biomass resources and their classification and biomass energy programme in India.

Course Outcomes (CO): Student will be able to

- To know about overview of Energy to waste and classification of waste.
- To acquire knowledge on bio mass pyrolysis, gasification, combustion and conversion process in detail.
- To gain knowledge on properties of biogas, biomass resources and programmes to convert waste to energy in India.

UNIT - I Lecture Hrs:10

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT - II Lecture Hrs:10

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT - III Lecture Hrs:12

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation

UNIT - IV Lecture Hrs:12

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

UNIT - V Lecture Hrs:10

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification -

Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification- pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Textbooks:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 2018
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., TMH, 2017

Reference Books:

1. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
2. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley

& Sons, 1996
Online Learning Resources:
https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-ch13/ https://www.youtube.com/watch?v=x2KmjbCvKTk

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

SEMESTER – I

S. No.	Course codes	Course Name	Category	Hours per			Credits
				L	T	P	
1.	21D58101	Advanced Data Structures and Algorithms	PC	3	0	0	3
2.	21D58102	Advanced Computer Networks	PC	3	0	0	3
3.	21D58103a 21D58103b 21D5813c	**Program Elective Course - I** Machine Learning Object Oriented Software Engineering Digital Image &Video Processing	PE	3	0	0	3
4.	21D58104a 21D58104b 21D58104c	**Program Elective Course - II** Data Science Design Patterns Information Security	PE	3	0	0	3
5.	21D58105	Advanced Data Structures and Algorithms Lab	PC	0	0	4	2
6.	21D58106	Advanced Computer Networks Lab	PC	0	0	4	2
7.	21DRM101	Research Methodology and IPR	MC	2	0	0	2
8.	21DAC101a 21DAC101b 21DAC101c	**Audit Course – I** English for Research paper writing Disaster Management Sanskrit for Technical Knowledge	AC	2	0	0	0
Total							**18**

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI
SEMESTER – II

S.No.	Course codes	Course Name	Category	Hours per week L	T	P	Credits
1.	21D58201	Advanced Operating Systems	PC	3	0	0	3
2.	21D58202	Internet of Things	PC	3	0	0	3
3.	21D58203a 21D58203b 21D58203c	**Program Elective Course – III** Deep Learning Service Oriented Architecture Computer Vision	PE	3	0	0	3
4.	21D58204a 21D58204b 21D58204c	**Program Elective Course - IV** Data Visualization Techniques Distributed Systems Privacy Preserving Data Publishing	PE	3	0	0	3
5.	21D58205	Advanced Operating Systems Lab	PC	0	0	4	2
6.	21D58206	Internet of Things Lab	PC	0	0	4	2
7.	21D35207	Technical seminar	PR	0	0	4	2
8.	21DAC201a 21DAC201b 21DAC201c	**Audit Course – II** Pedagogy Studies Stress Management for Yoga Personality Development through Life Enlightenment Skills	AC	2	0	0	0
		Total					**18**

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

SEMSTER - III

S.No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	 21D58301a 21D58301b 21D58301c	**Program Elective Course – V** Software Defined Networks Reinforcement Learning Data Analytics	PE	3	0	0	3
2.	 21DOE301b 21DOE301c 21DOE301f	**Open Elective** Industrial Safety Business Analytics Optimization Techniques	OE	3	0	0	3
3.	21D58302	Dissertation Phase – I	PR	0	0	20	10
4.	21D58303	Co-curricular Activities					2
		Total					**18**

SEMESTER - IV

S.No.	Course codes	Course Name	Category	Hours per			Credits
				L	T	P	
1.	21D58401	Dissertation Phase – II	PR	0	0	32	16
Total							**16**

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED DATA STRUCTURES AND ALGORITHMS (Common to M.Tech CSE, CN, SE,AI & ML)	L	T	P	C
21D58101		3	0	0	3
	Semester	I			

Course Objectives:

- To understand concepts of dictionaries and hash tables.
- To implement lists and trees.
- To analyze usage of B trees, Splay trees and 2-3 trees.
- To understand the importance of text processing and computational Geometry.

Course Outcomes (CO): Student will be able to

- Understand the implementation of symbol table using hashing techniques
- Apply advanced abstract data type (ADT) and data structures in solving real world
- problem
- Effectively combine the fundamental data structures and algorithmic techniques in
- building a solution to a given problem
- Develop algorithms for text processing applications

UNIT - I		Lecture Hrs:

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 - II		Lecture Hrs:

Skip Lists : Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists, Trees: Binary Search Trees (BST), AVL Trees, Red Black Trees: Height of a Red Black Tree, Red Black Trees Bottom-Up Insertion, Top-Down Red Black Trees, Top-Down Deletion in Red Black Trees, Analysis of Operations.

UNIT - III		Lecture Hrs:

2-3 Trees , Advantage of 2-3 trees over Binary Search Trees, Search and Update Operations on 2-3 Trees, Analysis of Operations, B-Trees: Advantage of B- trees over BSTs, Height of B-Tree, Search and Update Operations on 2-3 Trees, Analysis of Operations, Splay Trees: Splaying, Search and Update Operations on Splay Trees, Amortized Analysis of Splaying.

UNIT - IV		Lecture Hrs:

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

UNIT - V		Lecture Hrs:

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

Textbooks:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, second Edition, Pearson, 2004.
2. T.H. Cormen, C.E. Leiserson, R.L.Rivest, Introduction to Algorithms, Third Edition Prentice Hall, 2009

Reference books:

1. Michael T. Goodrich, Roberto Tamassia, Algorithm Design, First Edition, Wiley, 2006.

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED COMPUTER NETWORKS	L	T	P	C
21D58102		3	0	0	3
	Semester	I			

Course Objectives:

The objective of this course is to build a solid foundation in computer networks concepts and design

- To understand computer network architectures, protocols, and interfaces.
- The OSI reference model and the Internet architecture network applications.
- The course will expose students to the concepts of traditional as well as modern day
- computer networks - wireless and mobile, multimedia-based.
- Students completing this course will understand the key concepts and practices employed
- in modern computer networking

Course Outcomes (CO): Student will be able to

- Analyse computer network architectures and estimate quality of service
- Design application-level protocols for emerging networks
- Analyse TCP and UDP traffic in data networks
- Design and analyse medium access methods, routing algorithms and IPv6 protocol for data networks
- Analyze Data Center Networks and Optical Networks

UNIT - I — Lecture Hrs:

Network Architecture, Performance: Bandwidth and Latency, High Speed Networks, Network-Centric View, Error Detection, Reliable Transmission, Ethernet and Multiple Access Networks, Overlay Networks: Routing Overlays, Peer-to-Peer Networks and Content Distribution Networks, Client-Server Networks, Delay-Tolerant Networks,

UNIT - II — Lecture Hrs:

Switching: Circuit-Switched Networks, Datagram Networks, Virtual-Circuit Networks, Message-Switched Networks, Asynchronous Transfer Mode: Evolution, Benefits, Concepts, Exploring Broadband Integrated Services Digital Network, Layer and Adaptation Layer, IPv4: Address Space, Notations, Classful, Classless, Network Address Translation, Datagram

UNIT - III — Lecture Hrs:

Fragmentation and Checksum IPv6 Addresses: Structure, Address Space, Packet Format and Extension Headers, ICMP, IGMP, ARP, RARP, Congestion Control and Resource Allocation: Problem, Issues, Queuing, TCP Congestion Control, Congestion-Avoidance Mechanisms and Quality of Service,

UNIT - IV — Lecture Hrs:

Internetworking: Intra-Domain and Inter-Domain Routings, Unicast Routing Protocols: RIP, OSPF and BGP, Multicast Routing Protocols: DVMRP, PIM-DM, PIM-SM, CBT, MSDP and MOSPF, Spanning Tree Algorithm, Optical Networking: SONET/SDH Standards, Traffic Engineering: Requirement, Traffic Sizing, Characteristics, Protocols, Time and Delay Considerations, Connectivity, Availability, Reliability and Maintainability and Throughput.

UNIT - V — Lecture Hrs:

Multimedia Over Internet: Transmission, IP Multicasting and VoIP, Domain Name System: Name Space, Domain Name Space, Distribution, Domains, Resolutions and Dynamic Domain Name System, SNMP, Security: IPSec, SSL/TLS, PGP and Firewalls, Datacenter Design and Interconnection Networks.

Textbooks:

1. Larry L. Peterson and Bruce S. Davie, Computer Networks: A System Approach, Fifth Edition, Morgan Kaufmann, Elsevier, 2012.
2. Behrouz A. Forouzan, Data Communications and Networking, McGraw Hill, Fifth Edition, 2017.

3. Chwan-Hwa (John) Wu, J. David Irwin, Introduction to Computer Networks and Cyber Security, CRC press, Taylor & Francis Group,2014
4. Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, Pearson, 5th Edition, 2014.

Reference Books:

1. Satish Jain Advanced Computer Networking: Concepts and Applications

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	MACHINE LEARNING (Common to M.Tech CSE, SE,AI & ML)	L	T	P	C
21D58103a		3	0	0	3
	Semester	I			

Course Objectives:

- To understand various key paradigms for machine learning approaches.
- To familiarize with the mathematical and statistical techniques used in machine learning.
- To understand and differentiate among various machine learning techniques.

Course Outcomes (CO): Student will be able to

- To formulate a machine learning problem
- Select an appropriate pattern analysis tool for analysing data in a given feature space.
- Apply pattern recognition and machine learning techniques such as classification and feature selection to practical applications and detect patterns in the data.

UNIT - I		Lecture Hrs:

Introduction: Definitions, Datasets for Machine Learning, Different Paradigms of Machine Learning, Data Normalization, Hypothesis Evaluation, VC-Dimensions and Distribution, Bias-Variance Tradeoff, Regression

UNIT - II		Lecture Hrs:

Bayes Decision Theory: Bayes decision rule, Minimum error rate classification, Normal density and discriminant functions.
Parameter Estimation: Maximum Likelihood and Bayesian Parameter Estimation

UNIT - III		Lecture Hrs:

Discriminative Methods: Distance-based methods, Linear Discriminant Functions, Decision Tree, Random Decision Forest and Boosting
Feature Selection and Dimensionality Reduction: PCA, LDA, ICA, SFFS, SBFS

UNIT - IV		Lecture Hrs:

Learning from unclassified data. Clustering. Hierarchical Agglomerative Clustering. k-means partitional clustering. Expectation maximization (EM) for soft clustering. Semi-supervised learning with EM using labelled and unlabelled data.

UNIT - V		Lecture Hrs:

Kernel Machines: Kernel Tricks, SVMs (primal and dual forms), K-SVR, K-PCA (6 Lectures) Artificial Neural Networks: MLP, Backprop, and RBF-Net

Textbooks:

1. Shalev-Shwartz,S., Ben-David,S., (2014), Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press
2. R. O. Duda, P. E. Hart, D. G. Stork (2000), Pattern Classification, Wiley-Blackwell, 2nd Edition.

Reference Books:

1. Machine Learning Methods in the Environmental Sciences, Neural Networks, William W Hsieh, Cambridge Univ Press.
2. Richard o. Duda, Peter E. Hart and David G. Stork, pattern classification, John Wiley & Sons Inc.,2001
3. Chris Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 1995

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	OBJECT ORIENTED SOFTWARE ENGINEERING	L	T	P	C
21D58103b		3	0	0	3
	Semester	I			

Course Objectives:

- To learn and understand various O-O concepts along with their applicability contexts.
- Given a problem, identify domain objects, their properties, and relationships among them.
- How to identify and model/represent domain constraints on the objects and (or) on their relationships
- To learn various modelling techniques to model different perspectives of object-oriented software design (UML)

Course Outcomes (CO): Student will be able to

- Discuss about software development process models
- Identify the contemporary issues and discuss about coding standards
- Recognize the knowledge about testing methods and comparison of various testing techniques.
- Use the concept and standards of quality and getting knowledge about software quality assurance group.

UNIT - I Lecture Hrs:

Introduction to Software Engineering - Software Development process models – Agile Development - Project & Process - Project management - Process& Project metrics - Object Oriented concepts, Principles & Methodologies.

UNIT - II Lecture Hrs:

Software Requirements Specification, Software prototyping - Software project planning - Scope - Resources - Software Estimation - Empirical Estimation Models – Planning - Risk Management - Software Project Scheduling - Object Oriented Estimation & Scheduling.

UNIT - III Lecture Hrs:

Analysis Modelling - Data Modelling - Functional Modelling& Information Flow - BehaviouralModelling-Structured Analysis - Object Oriented Analysis - Domain Analysis-Object oriented Analysis process - Object Relationship Model - Object Behaviour Model, Design modelling with UML.

UNIT - IV Lecture Hrs:

Design Concepts & Principles - Design Process - Design Concepts - Modular Design - Design Effective Modularity - Introduction to Software Architecture - Data Design - Transform Mapping - Transaction Mapping - Object Oriented Design - System design process- Object design process - Design Patterns.

UNIT - V Lecture Hrs:

Top - Down, Bottom-Up, object oriented product Implementation & Integration. Software Testing methods-White Box, Basis Path-Control Structure - Black Box - Unit Testing - Integration testing - Validation & System testing - Testing Tools – Software Maintenance &Reengineering.

Textbooks:

1. Fairley R, “Software Engineering Concepts”, second edition, Tata McGraw Hill,NewDelhi, 2003.
2. Jalote P, “An Integrated Approach to Software Engineering”, third edition, NarosaPublishers, New Delhi, 2013.

Reference Books:

1. Grady Booch, James Rumbaugh, Ivar Jacobson - "the Unified Modeling Language User Guide" - Addison Wesley, 1999.
2. Ali Bahrami, “Object Oriented Systems Development” 1st Edition, The McGraw-Hill Company, 1999

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	DIGITAL IMAGE AND VIDEO PROCESSING	L	T	P	C
21D58103c		3	0	0	3
	Semester	I			

Course Objectives:

- To study the image fundamentals and mathematical transforms necessary for image Processing.
- To study the image enhancement techniques
- To study image restoration procedures.
- To study the image compression procedures.

Course Outcomes (CO): Student will be able to

- Review the fundamental concepts of a digital image processing system.
- Analyse images in the frequency domain using various transforms.
- Evaluate the techniques for image enhancement and image restoration.
- Categorize various compression techniques

UNIT - I Lecture Hrs:

Introduction, Image sampling, Quantization, Resolution, Image file formats, Elements of image processing system, Applications of Digital image processing. Introduction, Need for transform, image transforms, Fourier transform, 2 D Discrete Fourier transform and its transforms, Importance of phase, Walsh transform, Hadamard transform, Haar transform, slant transform Discrete cosine transform, KL transform, singular value decomposition, Radon transform, comparison of different image transforms

UNIT - II Lecture Hrs:

Spatial domain methods: Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters. Frequency domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, Selective filtering.

Introduction to Image restoration, Image degradation, Types of image blur, Classification of image restoration techniques, Image restoration model, Linear and Nonlinear image restoration techniques, Blind de-convolution.

UNIT - III Lecture Hrs:

Image Segmentation: Introduction to image segmentation, Point, Line and Edge Detection, Region based segmentation., Classification of segmentation techniques, Region approach to image segmentation, clustering techniques, Image segmentation based on thresholding, Edge based segmentation, Edge detection and linking, Hough transform, Active contour Image Compression: Introduction, Need for image compression, Redundancy in images, Classification of redundancy in images, image compression scheme, Classification of image compression schemes, Fundamentals of information theory, Run length coding, Shannon – Fano coding, Huffman coding, Arithmetic coding, Predictive coding, Transformed based compression, Image compression standard, Wavelet-based image compression, JPEG Standards.

UNIT - IV Lecture Hrs:

Basic Steps of Video Processing: Analog Video, Digital Video. Time-Varying Image Formation models: Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image Formation, Sampling of Video signals, Filtering operations.

UNIT - V Lecture Hrs:

2-D Motion Estimation: Optical flow, General Methodologies, Pixel Based Motion Estimation, Block Matching Algorithm, Mesh based Motion Estimation, Global Motion Estimation, Region based Motion Estimation, Multi resolution motion estimation, Waveform based coding, Block based transform coding, Predictive coding, Application of motion estimation in Video coding.

Textbooks:

1. Digital Image Processing – Gonzaleze and Woods, 3rdEd., Pearson.
2. Video Processing and Communication – Yao Wang, JoemOstermann and Ya–quin Zhang.1st Ed., PH Int.

	Reference Books:
1.	S.Jayaraman, S.Esakkirajan and T.VeeraKumar, “Digital Image processing, TataMcGraw Hill publishers, 2009

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	DATA SCIENCE	L	T	P	C
21D58104a		3	0	0	3
	Semester	I			

Course Objectives:

- Provide you with the knowledge and expertise to become a proficient data scientist.
- Demonstrate an understanding of statistics and machine learning concepts that are vital for
- data science;
- Produce Python code to statistically analyse a dataset;
- Critically evaluate data visualizations based on their design and use for communicating
- stories from data;

Course Outcomes (CO): Student will be able to

- Explain how data is collected, managed and stored for data science;
- Understand the key concepts in data science, including their real-world applications and the
- toolkit used by data scientists;
- Implement data collection and management scripts using MongoDB

UNIT - I Lecture Hrs:

Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.

UNIT - II Lecture Hrs:

Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources

UNIT - III Lecture Hrs:

Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance ,Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes

UNIT - IV Lecture Hrs:

Data visualization: Introduction, Types of data visualisation, Data for visualisation: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings

UNIT - V Lecture Hrs:

Applications of Data Science, Technologies for visualisation, Bokeh (Python) Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science

Textbooks:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly.
2. Jure Leskovek, AnandRajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press

Reference Books:

1. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. MIT Press, 2013.
2. Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking. O'Reilly, 2013.
3. Trevor Hastie, Robert Tibshirani and Jerome Friedman. Elements of Statistical Learning, Second Edition. Springer, 2009.
4. Avrim Blum, John Hopcroft and RavindranKannan. Foundations of Data Science.2018.
5. Mohammed J. Zaki and Wagner Miera Jr. Data Mining and Analysis: Fundamental Concepts and Algorithms. Cambridge University Press, 2014.
6. Jiawei Han, MichelineKamber and Jian Pei. Data Mining: Concepts and Techniques, Third Edition. Morgan Kaufmann, 2011.

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	DESIGN PATTERNS (Common to M.Tech CSE, CN, SE)	L	T	P	C
21D58104b		3	0	0	3
	Semester	I			

Course Objectives:

- Understand the concept of Design patterns and its importance.
- Understand the behavioural knowledge of the problem and solutions.
- Relate the Creational, Structural ,behavioural Design patterns.
- Apply the suitable design patterns to refine the basic design for given context

Course Outcomes (CO): Student will be able to

- Identify the appropriate design patterns to solve objectoriented design problems.
- Develop design solutions using creational patterns.
- Apply structural patterns to solve design problems.
- Construct design solutions by using behavioral patterns.

UNIT - I Lecture Hrs:

Introduction : What Is a Design Pattern?, Design Patterns in Smalltalk MVC, Describing Design Patterns, The Catalog of Design Patterns, Organizing the Catalog, How Design Patterns Solve Design Problems, How to Select a Design Pattern, How to Use a Design Pattern.

UNIT - II Lecture Hrs:

A Case Study : Designing a Document Editor : Design Problems, Document Structure, Formatting, Embellishing the User Interface, Supporting Multiple Look-and-Feel Standards, Supporting Multiple Window Systems, User Operations Spelling Checking and Hyphenation, Summary .

UNIT - III Lecture Hrs:

Creational Patterns: Abstract Factory, Builder, Factory Method, Prototype, Singleton, Discussion of Creational Patterns.Structural Pattern Part-I : Adapter, Bridge, Composite.

UNIT - IV Lecture Hrs:

Structural Pattern Part-II : Decorator, Façade, Flyweight, Proxy.Behavioural Patterns Part-I : Chain of Responsibility, Command, Interpreter, Iterator.

UNIT - V Lecture Hrs:

Behavioral Patterns Part-II : Mediator, Memento, Observer, State, Strategy, Template Method ,Visitor, Discussion of Behavioral Patterns.

Textbooks:

1. Design Patterns By Erich Gamma, Pearson Education

Reference Books:

1. Erich Gamma , Richard Helm, Ralph Johnson, John Vlissides , Grady Booch
Design Patterns: Elements of Reusable Object-Oriented Software

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	INFORMATION SECURITY	L	T	P	C
21D58104c		3	0	0	3
	Semester	I			

Course Objectives:

- To understand basics of Cryptography and Network Security.
- To be able to secure a message over insecure channel by various means.
- To learn about how to maintain the Confidentiality, Integrity and Availability of a Data
- To understand various protocols for network security to protect against the threats in the networks.

Course Outcomes (CO): Student will be able to

- Provide security of the data over the network.
- Do research in the emerging areas of cryptography and network security.
- Implement various networking protocols.
- Protect any network from the threats in the world

UNIT - I Lecture Hrs:

Security Attacks (Interruption, Interception, Modification and Fabrication), Security Services (Confidentiality, Authentication, Integrity, Non-repudiation, access Control and Availability) and Mechanisms, A model for Internetwork security, Internet Standards and RFCs, Buffer overflow & format string vulnerabilities, TCP session hijacking, ARP attacks, route table modification, UDP hijacking, and man-in-the-middle attacks.

UNIT - II Lecture Hrs:

Conventional Encryption Principles, Conventional encryption algorithms, cipher block modes of operation, location of encryption devices, key distribution Approaches of Message Authentication, Secure Hash Functions and HMAC.

UNIT - III Lecture Hrs:

Public key cryptography principles, public key cryptography algorithms, digital signatures, digital Certificates, Certificate Authority and key management Kerberos, X.509 Directory Authentication Service.

UNIT - IV Lecture Hrs:

Email privacy: Pretty Good Privacy (PGP) and S/MIME.IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management.

UNIT - V Lecture Hrs:

Web Security Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET).Basic concepts of SNMP, SNMPv1 Community facility and SNMPv3. Intruders, Viruses and related threats.

Textbooks:

1. Network Security Essentials (Applications and Standards) by William Stallings Pearson Education.
2. Hack Proofing your network by Ryan Russell, Dan Kaminsky, Rain Forest Puppy, Joe Grand, David Ahmad, Hal Flynn IdoDubrawsky, Steve W.Manzuik and Ryan Permeh, wileyDreamtech,
3. Cryptography and network Security, Third edition, Stallings, PHI/Pearson

Reference Books:

1. Network Security and Cryptography‖, Bernard Menezes ,Cengage Learning.
2. Cryptography and Security‖, C.K. Shymala, N. Harini and Dr. T.R. Padmanabhan, Wiley-India.
3. Applied Cryptography, Bruce Schiener, 2nd edition, John Wiley & Sons.
4. Cryptography and Network Security‖, AtulKahate, TMH.
5. ‗Introduction to Cryptography‖, Buchmann, Springer.
6. ‗Number Theory in the Spirit of Ramanujan‖, Bruce C.Berndt, University Press
7. Introduction to Analytic Number Theory‖, Tom M.Apostol, University Press

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED DATA STRUCTURES AND ALGORITHMS LAB (Common to M.Tech CSE, CN, SE,AI & ML)	L	T	P	C
21D58105		0	0	4	2
	Semester	I			

Course Objectives:

- Implement linear and non linear data structures.
- Analyze various algorithms based on their time complexity.
- Choose appropriate data structure and algorithm design method for a specific application.
- Identify suitable data structure to solve various computing problems.

Course Outcomes (CO):

- Implement divide and conquer techniques to solve a given problem.
- Implement hashing techniques like linear probing, quadratic probing, random probing and double hashing/rehashing.
- Perform Stack operations to convert infix expression into post fix expression and evaluate the post fix expression.
- Differentiate graph traversal techniques Like Depth First Search, Breadth First Search. Identify shortest path to other vertices using various algorithms.

List of Experiments:

- To implement functions of Dictionary using Hashing (division method, Multiplication method, Universal hashing).
- To perform various operations i.e., insertions and deletions on AVL trees.
- To perform various operations i.e., insertions and deletions on 2-3 trees.
- To implement operations on binary heap.
- To implement operations on graphs
- To implement Depth First Search for a graph non-recursively.
- To implement Breadth First Search for a graph non-recursively.
- To implement Prim’s algorithm to generate a min-cost spanning tree.
- To implement Krushkal’s algorithm to generate a min-cost spanning tree.
- To implement Dijkstra’s algorithm to find shortest path in the graph.

Course Code	**ADVANCED COMPUTER NETWORKS LAB**	**L**	**T**	**P**	**C**
21D58106		**0**	**0**	**4**	**2**
	Semester	**I**			

Course Objectives:

- Aims to provide advanced background on relevant computer networking topics to have a comprehensive and deep knowledge in computer networks

Course Outcomes (CO):

Develop programs for client-server applications
Perform packet sniffing and analyze packets in network traffic.
Implement error detecting and correcting codes
Implement network security algorithms

List of Experiments:

1. Implementation of client server programs for different network applications
2. Study and analysis of the network using Wireshark network protocol analyser
3. Implementation of topology generation for network simulation
4. Implementation of queuing management
5. Implementation of MAC-layer protocols
6. Implementation of routing protocols
7. Implementation of transport-layer protocols
8. Implementation of network security mechanisms

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	RESEARCH METHODOLOGY AND IPR (Common to M.Tech CSE, CN, SE,AI & ML)	L	T	P	C
21DRM101		2	0	0	2
	Semester	I			

Course Objectives:

- Identify an appropriate research problem in their interesting domain.
- Understand ethical issues understand the Preparation of a research project thesis report.
- Understand the Preparation of a research project thesis report
- Understand the law of patent and copyrights.
- Understand the Adequate knowledge on IPR

Course Outcomes (CO): Student will be able to

- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT - I | Lecture Hrs:

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, scope, and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT - II | Lecture Hrs:

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT - III | Lecture Hrs:

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT - IV | Lecture Hrs:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT - V

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Textbooks:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

Reference Books:

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.

5. Asimov, “Introduction to Design”, Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED OPERATING SYSTEMS	L	T	P	C
21D58201		3	0	0	3
	Semester	II			

Course Objectives:

- To be able to read and understand sample open source programs and header files.
- System calls which explore networking and security Applications..
- To acquire the knowledge in the implementation of interprocess communication.

Course Outcomes (CO): Student will be able to

- To explain the functionality of a large software system by reading its source.
- To revise any algorithm present in a system.
- Inter process communication mechanism
- Android mobiles inner process system

UNIT - I Lecture Hrs:

Basic Operating System Concepts - Overview of Unix File System - Files - Links - Types - Inodes -Access Rights - System Calls - Overview of Unix Kernels -Model - Implementation - Reentrant Kernels - Address Space - Synchronization - Interprocess Communication - Process Management - Memory Management - Device Drivers.

UNIT - II Lecture Hrs:

Processes, Lightweight Processes, and Threads - Process Descriptor - State - Identifying a Process - Relationships among processes - Organization - Resource Limits - Creating Processes - System Calls - Kernel Threads - Destroying Processes -Termination - Removal.

UNIT - III Lecture Hrs:

The Virtual File System (VFS) - Role - File Model -System Calls - Data Structures - Super Block, Inode, File, dentry Objects - dentry Cache - Files Associated with a Process - Filesystem Types - Special Files systems – Filesystem Type Registration – Filesystem Handling - Namespaces - Mounting – Unmounting - Implementation of VFS System Calls.

UNIT - IV Lecture Hrs:

Windows Operating system - versions, Concepts and tools, Windows internals, System Architecture, Requirements and design goals, Operating system model, Architecture overview. Key system components. System mechanisms - Trap dispatching, object manager, Synchronization, System worker threads, Windows global flags, Local procedural calls, Kernelevent tracing.

UNIT - V Lecture Hrs:

what is android, basic building blocks – activities, services, broadcast receivers & content, ui components-views & notifications, components for communication -intents & intent filters, android api levels launching emulator editing emulator settings emulator shortcuts log cat usage, Applications of Android.

Textbooks:

1. Daniel P. Bovet and Marco Cesati, "Understanding the Linux Kernel", 3rd Edition, O'Reilly Publications, 2005.
2. Harold Abelson, Gerald Jay Sussman and Julie Sussman, ―Structure and Interpretation of Computer Programs‖, Second Edition, Universities Press, 2013.

Reference Books:

1. Mark E. Russinovich and David A. Solomon, Microsoft Windows Internals, 4th Edition, Microsoft Press, 2004.

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	INTERNET OF THINGS	L	T	P	C
21D58202		3	0	0	3
	Semester		II		

Course Objectives:

Introduce the fundamental concepts of IoT and physical computing

- Expose the student to a variety of embedded boards and IoT Platforms
- Create a basic understanding of the communication protocols in IoT communications.
- Familiarize the student with application program interfaces for IoT.
- Enable students to create simple IoT applications.

Course Outcomes (CO): Student will be able to

- Choose the sensors and actuators for an IoT application
- Select protocols for a specific IoT application
- Utilize the cloud platform and APIs for IoT applications
- Experiment with embedded boards for creating IoT prototypes
- Design a solution for a given IoT application
- Establish a startup

UNIT - I — Lecture Hrs:

Overview of IoT:
The Internet of Things: An Overview, The Flavor of the Internet of Things, The "Internet" of "Things", The Technology of the Internet of Things, Enchanted Objects, Who is Making the Internet of Things?
Design Principles for Connected Devices: Calm and Ambient Technology, Privacy, Web Thinking for Connected Devices, Affordances.
Prototyping: Sketching, Familiarity, Costs Vs Ease of Prototyping, Prototypes and Production, Open source Vs Close source, Tapping into the community.

UNIT - II — Lecture Hrs:

Embedded Devices:
Electronics, Embedded Computing Basics, Arduino, Raspberry Pi, Mobile phones and tablets, Plug Computing: Always-on Internet of Things

UNIT - III — Lecture Hrs:

Communication in the IoT:
Internet Communications: An Overview, IP Addresses, MAC Addresses, TCP and UDP Ports, Application Layer Protocols
Prototyping Online Components:
Getting Started with an API, Writing a New API, Real-Time Reactions, Other Protocols Protocol

UNIT - IV — Lecture Hrs:

Business Models: A short history of business models, The business model canvas, Who is the business model for, Models, Funding an Internet of Things startup, Lean Startups.
Manufacturing: What are you producing, Designing kits, Designing printed circuit boards.

UNIT - V — Lecture Hrs:

Manufacturing continued: Manufacturing printed circuit boards, Mass-producing the case and other fixtures, Certification, Costs, Scaling up software.
Ethics: Characterizing the Internet of Things, Privacy, Control, Environment, Solutions

Textbooks:

1.Adrian McEwen, Hakim Cassimally - Designing the Internet of Things, Wiley Publications, 2012

Reference Books:

1. HaiderRaad Fundamentals of IoT and Wearable Technology Design, Wiley Publications2020.
2. KashishAraShakil,Samiya Khan, Internet of Things (IoT) Concepts and Applications,Springer Publications 2020.

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	DEEP LEARNING	L	T	P	C
21D58203a		3	0	0	3
	Semester	II			

Course Objectives:

- To present the mathematical, statistical and computational challenges of building neural networks.
- To teach the concepts of deep learning.
- To introduce dimensionality reduction techniques.
- To enable the students to know deep learning techniques to support real-time applications.
- To explain the case studies of deep learning techniques.

Course Outcomes (CO): Student will be able to

- Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
- Implement deep learning algorithms and solve real-world problems.

UNIT - I Lecture Hrs:

Introduction: Introduction to machine learning- Linear models (SVMs and Perceptron's, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates.

UNIT - II Lecture Hrs:

Deep Networks: History of Deep Learning- A Probabilistic Theory of Deep Learning- Back propagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks Convolutional Networks - Generative Adversarial Networks (GAN), Semi-supervised Learning .

UNIT - III Lecture Hrs:

Dimensionality Reduction: Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyper parameter optimization.

UNIT - IV Lecture Hrs:

Optimization and Generalization: Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience.

UNIT - V Lecture Hrs:

Case Study and Applications: Image net- Detection-Audio Wave Net-Natural Language Processing Word2Vec - Joint Detection Bioinformatics- Face Recognition- Scene Understanding- Gathering Image Captions.

Textbooks:

1. Deep Learning", Ian Goodfellow, YoshuaBengio , Aaron Courville, MIT Press 2016.

Reference Books:

1. "Neural Networks and Deep Learning A Text Book", Charu C Aggarwal, Springer International
Publishing AG, Part of Springer Nature 2018.

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	SERVICE ORIENTED ARCHITECTURE	L	T	P	C
21D58203b		3	0	0	3
	Semester	II			

Course Objectives:

- Understand SOA and evolution of SOA.
- Understand web services and primitive, contemporary SOA.
- Understand various service layers.
- Understand service-oriented analysis and design based on guidelines.

Course Outcomes (CO): Student will be able to

- Comprehend the need for SOA and its systematic evolution
- Apply SOA technologies to enterprise domain
- Design and analyse various SOA patterns and techniques
- Compare and evaluate best strategies and practices of SOA

UNIT - I — Lecture Hrs:

Introducing SOA: Fundamental SOA, Common Characteristics of Contemporary SOA, Common Tangible Benefits of SOA, Common Pitfalls of Adopting SOA.
The Evolution of SOA: An SOA Timeline, The Continuing Evolution of SOA, The Roots of SOA.

UNIT - II — Lecture Hrs:

Web Services and Primitive SOA: The Web Services Frame Work, Services, Service Descriptions, Messaging.
Web Services and Contemporary SOA (Part I-Activity management and Composition): Message Exchange Patterns, Service Activity, Coordination, Atomic Transactions, Orchestration, and Choreography.
Web Services and Contemporary SOA (Part-II-Advanced Messaging, Metadata and Security): Addressing, Reliable Messaging, Correlation, Policies, Metadata exchange, Security.

UNIT - III — Lecture Hrs:

Principles of Service-Orientation: Service–Orientation and the Enterprise, Anatomy of SOA, Common Principles of Service–Orientation, Interrelation between Principles of Service- Orientation, Service Orientation and Object Orientation, Native Web Services Support for Principles of Service-Orientation.
Service Layers: Service-Orientation and Contemporary SOA, Service Layer abstraction, Application Service Layer, Business Service Layer, Orchestration Service Layer, Agnostic Services, Service Layer Configuration Scenarios.

UNIT - IV — Lecture Hrs:

SOA Delivery Strategies: SOA Delivery Lifecycle Phases, The Top-Down Strategy, The Bottom-up Strategy, The Agile Strategy.
Service Oriented Analysis (Part I-Introduction): Introduction to Service Oriented Analysis, Benefits of a Business Centric SOA, Deriving Business Services.
Service Oriented Analysis (Part-II-Service Modelling): Service Modelling, Service Modelling Guidelines, Classifying Service Model Logic, Contrasting Service Modelling Approaches.
Service Oriented Design (Part I-Introduction): Introduction to Service-Oriented Design, WSDL Related XML Schema Language Basics, WSDL Language Basics, Service Interface Design Tools.
Service Oriented Design (Part II-SOA Composition Guidelines): SOA Composing Steps, Considerations for Choosing Service Layers, Considerations for Positioning Core SOA Standards, Considerations for Choosing SOA Extensions.

UNIT - V — Lecture Hrs:

Service Oriented Design (Part III- Service Design): Service Design Overview, Entity- Centric Business Service Design, Application Service Design, Task-Centric Business Service Design, Service Design Guidelines.
Service Oriented Design (Part IV-Business Process Design): WS-BPEL Language Basics, WS- Coordination Overview, Service Oriented Business Process Design.

Textbooks:

1. Service-Oriented Architecture-Concepts, Technology, and Design, Thomas Erl, Pearson Education, 2006.

2.Understanding SOA with Web Services, Eric Newcomer, Greg Lomow, Pearson Education, 2005.
Reference Books:
1. Thomas Erl; Service Oriented Architecture Concepts Technology & Design, Pearson Education Limited; 2015, ISBN-13: 9788131714904. 2 Guido Schmutz, Peter Welkenbach, Daniel Liebhart; Service Oriented Architecture An Integration Blueprint; Shroff Publishers & Distributors; 2010, ISBN-13: 9789350231081

M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	COMPUTER VISION (Common to M.Tech CSE, AI & ML)	L	T	P	C
21D58203c		3	0	0	3
	Semester		II		

Course Objectives:

- Be familiar with both the theoretical and practical aspects of computing with images.
- Have described the foundation of image formation, measurement, and analysis.
- Understand the geometric relationships between 2D images and the 3D world.
- Grasp the principles of state-of-the-art deep neural networks

Course Outcomes (CO): Student will be able to

- Develop the practical skills necessary to build computer vision applications.
- To have gained exposure to object and scene recognition and categorization from images

UNIT - I		Lecture Hrs:

Overview, computer imaging systems, lenses, Image formation and sensing,
Image analysis, pre-processing and Binary image analysis

UNIT - II		Lecture Hrs:

Edge detection, Edge detection performance, Hough transform, corner detection

UNIT - III		Lecture Hrs:

Segmentation, Morphological filtering, Fourier transform

UNIT - IV		Lecture Hrs:

Feature extraction, shape, histogram, colour, spectral, texture, using CVIPtools, Feature analysis, feature vectors, distance /similarity measures, data pre-processing

UNIT - V		Lecture Hrs:

Pattern Analysis:
Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi supervised
Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA, and Non-parametric methods

Textbooks:

1. Computer Vision: Algorithms and Applications by Richard Szeliski.

Reference Books:

1. Deep Learning, by Goodfellow, Bengio, and Courville.
2. Dictionary of Computer Vision and Image Processing, by Fisher et al.

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	DATA VISUALIZATION TECHNIQUES	L	T	P	C
21D58204a		3	0	0	3
	Semester	II			

Course Objectives:

- To develop skills to both design and critique visualizations.
- To introduce visual perception and core skills for visual analysis.
- To understand visualization for time-series analysis.
- To understand visualization for ranking analysis.
- To understand visualization for deviation analysis..

Course Outcomes (CO): Student will be able to

- Explain principles of visual perception
- Apply core skills for visual analysis
- Apply visualization techniques for various data analysis tasks
- Design information dashboard

UNIT - I		Lecture Hrs:

Information visualization – effective data analysis – traits of meaningful data – visual perception – making abstract data visible – building blocks of information visualization – analytical interaction – analytical navigation – optimal quantitative scales – reference lines and regions – trellises and crosstabs – multiple concurrent views – focus and context – details on demand – over-plotting reduction – analytical patterns – pattern examples.

UNIT - II		Lecture Hrs:

Distribution analysis – describing distributions – distribution patterns – distribution displays – distribution analysis best practices – correlation analysis – describing correlations – correlation patterns – correlation displays – correlation analysis techniques and best practices – multivariate analysis – multivariate patterns – multivariate displays – multivariate analysis techniques and best practices.

UNIT - III		Lecture Hrs:

Information dashboard – Introduction– dashboard design issues and assessment of needs – Considerations for designing dashboard-visual perception – Achieving eloquence.

UNIT - IV		Lecture Hrs:

Advantages of Graphics _Library of Graphs – Designing Bullet Graphs – Designing Sparklines – Dashboard Display Media –Critical Design Practices – Putting it all together- Unveiling the dashboard.

UNIT - V		Lecture Hrs:

Plotting Geospatial Data: Introduction to Geoplotlib, Design Principles of Geoplotlib, Geospatial Visualizations, Plotting Geospatial Data on a Map Web-Based Visualizations: Concepts of Bokeh, Interfaces-Plotting and Model Interfaces, Output, Bokeh Server, Presentation, Integrating – HTML Document and Bokeh Applications

Textbooks:

1. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.
2. Mario Dobler, Tim Grobmann, “Data Visualization with Python”, O’Reilly, First Edition, 2019

Reference Books:

1. Stephen Few, "Information dashboard design: Displaying data for at-a-glance monitoring", second edition, Analytics Press, 2013.

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	DISTRIBUTED SYSTEMS	L	T	P	C
21D58204b		3	0	0	3
	Semester	II			

Course Objectives:

To introduce the fundamental concepts and issues of managing large volume of shared data in a parallel and distributed environment, and to provide insight into related research problems

Course Outcomes (CO): Student will be able to

- Design trends in distributed systems.
- Apply network virtualization.
- Apply remote method invocation and objects

UNIT - I Lecture Hrs:

Distributed data processing; What is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts

DISTRIBUTED DATABASE MANAGEMENT SYSTEM ARCHITECTURE Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues

UNIT - II Lecture Hrs:

DISTRIBUTED DATABASE DESIGN

Alternative design strategies; Distributed design issues; Fragmentation; Data Allocation

SEMANTICS DATA CONTROL

View management; Data security; Semantic Integrity Control

QUERY PROCESSING ISSUES

Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data

UNIT - III Lecture Hrs:

Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms

TRANSACTION MANAGEMENT

The transaction concept; Goals of transaction management; Characteristics oftransactions; Taxonomy of transaction models

CONCURRENCY CONTROL

Concurrency control in centralized database systems; Concurrency control in DDBSs;Distributed concurrency control algorithms; Deadlock management

UNIT - IV Lecture Hrs:

Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols

UNIT - V Lecture Hrs:

PARALLEL DATABASE SYSTEMS

Parallel architectures; parallel query processing and optimization; load balancing

ADVANCED TOPICS

Mobile Databases, Distributed Object Management, Multi-databases

Textbooks:

1. Principles of Distributed Database Systems, M.T. Ozsu and P. Valduriez, Prentice-Hall, 1991.

Reference Books:

1. Distributed Database Systems, D. Bell and J. Grimson, Addison-Wesley, 1992.

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	PRIVACY PRESERVING DATA PUBLISHING	L	T	P	C
21D58204c		3	0	0	3
	Semester	II			

Course Objectives:

- Will be able to decide, given an application, if it should be formulated as a data privacy problem. If yes, the students will be able to formally define the problem and state what properties can be guaranteed by applying differential privacy.
- Will have understanding of how (and why) randomness (or uncertainty) provides privacy protection.
- Will be able to analyse real-world privacy problems, identify which privacy-preserving methods are appropriate, and implement the private algorithms in code.
- Will be able to evaluate and compare privacy-preserving algorithms.

Course Outcomes (CO): Student will be able to

- Apply anonymization methods for sensitive data protection
- Apply state-of-art techniques for data privacy protection
- Design privacy preserving algorithms for real-world applications
- Identify security and privacy issues in OLAP systems
- Apply information metrics for Maximizing the preservation of information in the anonymization process

UNIT - I Lecture Hrs:

Fundamentals of defining privacy and developing efficient algorithms for enforcing privacy, challenges in developing privacy preserving algorithms in real-world applications, privacy issues, privacy models,

UNIT - II Lecture Hrs:

Anonymization operations, information metrics, Anonymization methods for the transaction data, trajectory data, social networks data, and textual data, Collaborative Anonymization,

UNIT - III Lecture Hrs:

Access control of outsourced data, Use of Fragmentation and Encryption to Protect Data Privacy, Security and Privacy in OLAP systems.

UNIT - IV Lecture Hrs:

Extended Data publishing Scenarios, Anonymization for Data Mining, publishing social science data,

UNIT - V Lecture Hrs:

Continuous user activity monitoring (like in search logs, location traces, energy monitoring), social networks, recommendation engines and targeted advertising.

Textbooks:

1. Benjamin C.M. Fung, Ke Wang, Ada Wai-Chee Fu and Philip S. Yu, Introduction to PrivacyPreserving Data Publishing: Concepts and Techniques, 1st Edition, Chapman & Hall/CRC, 2010.

Reference Books:

1. Bee-Chung Chen, Daniel Kifer, AshwinMachanavajjhala, Kristen LeFevre Privacy-Preserving Data Publishing ,Now Publishers Inc, 2009.

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	ADVANCED OPERATING SYSTEMS LAB	L	T	P	C
21D58205		0	0	4	2
	Semester	II			

Course Objectives:

- To study Linux memory management data structures and algorithms.
- To acquire the knowledge in the implementation of interprocess communication.
- To understand how program execution happens in Linux.

Course Outcomes (CO):

- To revise any algorithm present in a system.
- To design a new algorithm to replace an existing one.
- To appropriately modify and use the data structures of the linux kernel for a different software system

List of Experiments:

1. Write programs using the following system calls of UNIX operating system: 40 fork, exec, getpid, exit, wait, close, stat, opendir, readdir
2. Write programs using the I/O system calls of UNIX operating system (open, read, write, etc)
3. Write C programs to simulate UNIX commands like ls, grep, etc.
4. Given the list of processes, their CPU burst times and arrival times, display/print the Gantt chart for FCFS and SJF. For each of the scheduling policies, compute and print the average waiting time and average turnaround time. (2 sessions)
5. Given the list of processes, their CPU burst times and arrival times, display/print the Gantt chart for Priority and Round robin. For each of the scheduling policies, compute and print the average waiting time and average turnaround time. (2 sessions)
6. Developing Application using Inter Process communication (using shared memory, pipes or message queues)
7. Implement the Producer – Consumer problem using semaphores (using UNIX system calls).

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	INTERNET OF THINGS LAB	L	T	P	C
21D58206		0	0	4	2
	Semester	II			

Course Objectives:

- The main objective IOT applications is to know the different real time sensors used to measure the different electrical parameters and to control the different devices from anywhere through IOT.

Course Outcomes (CO):

- The students will be thorough about the technology behind the IoT and associated technologies
- The students will be able to use the IoT technologies in practical domains of society
- The students will be able to gain knowledge about the state of the art methodologies in IoT application domains.

List of Experiments:

1. Exercise on Eclipse IoT Project.
2. Experiments on few Eclipse IoT Projects.
3. Any Experiment on architecture of Iot Toolkit.
4. Exercise on smart object API Gateway service reference implementation in IoTToolkit.
5. Experiment on HTTP-to-CoAP semantic mapping Proxy in IoT Toolkit.
6. Experiment on Gate way as a service deployment in IoT Toolkit.
7. Experiment on application framework and embedded software agents for IoT Toolkit

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	SOFTWARE DEFINED NETWORKS	L	T	P	C
21D58301a		3	0	0	3
	Semester	III			

Course Objectives:

- This course introduces about software defined networking, an emerging paradigm in computer networking that allows a logically centralized software program to control the behavior of an entire network.

Course Outcomes (CO): Student will be able to

- Differentiate between traditional networks and software defined networks and understand the key benefits and use cases of SDN.
- Interpret the SDN data plane devices and OpenFlow Protocols
- Implement the operation of SDN control plane with different controllers
- Apply techniques that enable applications to control the underlying network using SDN
- Evaluate Network Functions Virtualization components and their roles in SDN

UNIT - I Lecture Hrs:

Evolving network requirements-The SDN Approach: Requirements, SDN Architecture, Characteristics of Software-Defined Networking, SDN and NFV-Related Standards: Standards-Developing Organizations, Industry Consortia, Open Development Initiatives.

UNIT - II Lecture Hrs:

SDN data plane: Data plane Functions, Data plane protocols, Open flow logical network Device: Flow table Structure, Flow Table Pipeline, The Use of Multiple Tables, Group Table- Open Flow Protocol.

UNIT - III Lecture Hrs:

SDN Control Plane Architecture: Control Plane Functions, Southbound Interface, Northbound Interface, Routing, ITU-T Model- OpenDaylight-REST- Cooperation and Coordination Among Controllers

UNIT - IV Lecture Hrs:

SDN Application Plane Architecture: Northbound Interface, Network Applications, User Interface- Network Services Abstraction Layer: Abstractions in SDN, Frenetic- Traffic Engineering Measurement and Monitoring Security- Data CentreNetworking- Mobility and Wireless.

UNIT - V Lecture Hrs:

Background and Motivation for NFV- Virtual Machines- NFV Concepts: Simple Example of the Use of NFV, NFV Principles, High-Level NFV Framework, NFV Benefits and Requirements- NFV Reference Architecture: NFV Management and Orchestration

Textbooks:

1. Paul Goransson Chuck Black Timothy Culver: Software Defined Networks: A Comprehensive Approach, Morgan Kaufmann, 2016.
2. Ken Gray Thomas Nadeau: Network Function Virtualization, Morgan Kaufmann, 2016.

Reference Books:

1. Larry Peterson , Carmelo Cascone , Bruce Davie: Software-Defined Networks: A Systems Approach, Systems Approach, 2021

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	REINFORCEMENT LEARNING	L	T	P	C
21D58301b	(Common for MTech CSE, AI & ML)	3	0	0	3
	Semester	III			

Course Objectives:

- Reinforcement Learning is a subfield of Machine Learning, but is also a general-purpose formalism for automated decision-making and AI. This course introduces you to statistical learning techniques where an agent explicitly takes actions and interacts with the world.

Course Outcomes (CO): Student will be able to

- Formulate Reinforcement Learning problems
- Apply various Tabular Solution Methods to Markov Reward Process Problems
- Apply various Iterative Solution methods to Markov Decision Process Problems
- Comprehend Function approximation methods

UNIT - I Lecture Hrs:

Introduction: Introduction to Reinforcement Learning (RL) – Difference between RL and Supervised Learning, RL and Unsupervised Learning. Elements of RL, Markov property, Markov chains, Markov reward process (MRP).

UNIT - II Lecture Hrs:

Evaluative Feedback - Multi-Arm Bandit Problem: An n-Armed Bandit Problem, Exploration vs Exploitation principles, Action value methods, Incremental Implementation, tracking a non-stationary problem, optimistic initial values, upper-confidence-bound action selection, Gradient Bandits. Introduction to and proof of Bellman equations for MRPs

UNIT - III Lecture Hrs:

Introduction to Markov decision process (MDP), state and action value functions, Bellman expectation equations, optimality of value functions and policies, Bellman optimality equations. Dynamic Programming (DP): Overview of dynamic programming for MDP, principle of optimality, Policy Evaluation, Policy Improvement, policy iteration, value iteration, asynchronous DP , Generalized Policy Iteration.

UNIT - IV Lecture Hrs:

Monte Carlo Methods for Prediction and Control: Overview of Monte Carlo methods for model free RL, Monte Carlo Prediction, Monte Carlo estimation of action values, Monto Carlo Control, On policy and off policy learning, Importance sampling. Temporal Difference Methods: TD Prediction, Optimality of TD(0), TD Control methods - SARSA, Q-Learning and their variants.

UNIT - V Lecture Hrs:

Eligibility traces: n-Step TD Prediction, Forward and Backward view of TD(λ), Equivalence of forward and backward view, Sarsa(λ),, Watkins's Q(λ), Off policy eligibility traces using importance of sampling. Function Approximation Methods: Value prediction with function approximation, gradient descent methods, Linear methods, control with function approximation.

Textbooks:

1. Richard S. Sutton and Andrew G. Barto, Reinforcement Learning: An Introduction", 2nd Edition, The MIT Press.
2. CsabaSzepesvari – Algorithms for Reinforcement Learning – Morgan & Claypool, 2010.

Reference Books:

1. Reinforcement Learning By Richard S. (University Of Alberta) Sutton,Andrew G. (Co-Director Autonomous Learning Laboratory) Barto

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	DATA ANALYTICS (Common to M.Tech CSE, SE)	L	T	P	C
21D58301c		3	0	0	3
	Semester	III			

Course Objectives:

- To explore the fundamental concepts of data analytics.
- To learn the principles and methods of statistical analysis
- Discover interesting patterns, analyze supervised and unsupervised models and estimate the accuracy of the algorithms.
- To understand the various search methods and visualization techniques.

Course Outcomes (CO): Student will be able to

- Understand the ideas of statistical approaches to learning
- Understand the significance of exploratory data analysis (EDA) in data science and apply basic tools (plots, graphs, summary statistics) to perform EDA
- Apply basic machine learning algorithms (Linear Regression, k-Nearest Neighbors (k-NN), k-means, Naive Bayes) for predictive modeling. Explore the merits of Naive Bayes technique
- Recognize the characteristics of machine learning techniques that are useful to solve real-world problems

UNIT - I		Lecture Hrs:

Introduction: What is Data Science? Big Data and Data Science hype and getting past the hype, Why now?, Datafication, Current landscape of perspectives, Skill sets, Life cycle of Data Science, Different phases.

UNIT - II		Lecture Hrs:

Exploratory Data Analysis and the Data Science Process: Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA, The Data Science Process, Case Study: RealDirect (online real estate firm), Three Basic Machine Learning Algorithms: Linear Regression, k-Nearest Neighbours (k-NN), k-means.

UNIT - III		Lecture Hrs:

One More Machine Learning Algorithm and Usage in Applications: Motivating application: Filtering Spam, Why Linear Regression and k-NN are poor choices for Filtering Spam, Naive Bayes and why it works for Filtering Spam, Data Wrangling: APIs and other tools for scrapping the Web, Feature Generation and Feature Selection (Extracting Meaning From Data), Motivating application: user (customer) retention,

UNIT - IV		Lecture Hrs:

Feature Generation (brainstorming, role of domain expertise, and place for imagination), Feature Selection algorithms: Filters; Wrappers; Decision Trees; Random Forests, Recommendation Systems: Building a User-Facing Data Product: Algorithmic ingredients of a Recommendation Engine, Dimensionality Reduction, Singular Value Decomposition, Principal Component Analysis, Exercise: build your own recommendation system.

UNIT - V		Lecture Hrs:

Data Visualization: Basic principles, ideas and tools for data visualization, Case study on industry projects, Exercise: create your own visualization of a complex dataset, Data Science and Ethical Issues: Discussions on privacy, security, ethics, A look back at Data Science, Next-generation data scientists.

Textbooks:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly, 2014.
2. Jure Leskovek, AnandRajaraman and Jerey Ullman. Mining of Massive Datasets, Cambridge University Press, 2014.

Reference Books:

1. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. MIT Press, 2013.
2. Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking. O'Reilly, 2013.
3. Trevor Hastie, Robert Tibshirani and Jerome Friedman. Elements of Statistical Learning, Second Edition. Springer, 2009.

4. Avrim Blum, John Hopcroft and RavindranKannan. Foundations of Data Science.2018.
5. Mohammed J. Zaki and Wagner Miera Jr. Data Mining and Analysis: Fundamental Concepts and Algorithms. Cambridge University Press, 2014.
6. Jiawei Han, MichelineKamber and Jian Pei. Data Mining: Concepts and Techniques, Third Edition. Morgan Kaufmann, 2011.

AUDIT COURSE-I

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
21DAC101a		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- Understand the essentials of writing skills and their level of readability
- Learn about what to write in each section
- Ensure qualitative presentation with linguistic accuracy

Course Outcomes (CO): Student will be able to

- Understand the significance of writing skills and the level of readability
- Analyze and write title, abstract, different sections in research paper
- Develop the skills needed while writing a research paper

UNIT - I — Lecture Hrs:10

1Overview of a Research Paper- Planning and Preparation- Word Order- Useful Phrases - Breaking up Long Sentences-Structuring Paragraphs and Sentences-Being Concise and Removing Redundancy -Avoiding Ambiguity

UNIT - II — Lecture Hrs:10

Essential Components of a Research Paper- Abstracts- Building Hypothesis-Research Problem - Highlight Findings- Hedging and Criticizing, Paraphrasing and Plagiarism, Cauterization

UNIT - III — Lecture Hrs:10

Introducing Review of the Literature – Methodology - Analysis of the Data-Findings - Discussion- Conclusions-Recommendations.

UNIT - IV — Lecture Hrs:9

Key skills needed for writing a Title, Abstract, and Introduction

UNIT - V — Lecture Hrs:9

Appropriate language to formulate Methodology, incorporate Results, put forth Arguments and draw Conclusions

Suggested Reading

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) Model Curriculum of Engineering & Technology PG Courses [Volume-I]
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	DISASTER MANAGEMENT	L	T	P	C
21DAC101b		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- Learn to demonstrate critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from Multiple perspectives.
- Developanunderstandingofstandardsofhumanitarianresponseandpracticalrelevanceinspecific types of disasters and conflict situations
- Criticallyunderstandthestrengthsandweaknessesofdisastermanagementapproaches,planningand programming in different countries, particularly their home country or the countries they work in

UNIT - I

Introduction:
Disaster:Definition,FactorsandSignificance;DifferenceBetweenHazardandDisaster;Naturaland Manmade Disasters: Difference, Nature, Types and Magnitude.

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:
Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes,Volcanisms,Cyclones,Tsunamis,Floods,DroughtsandFamines,Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT - III

Disaster Preparedness and Management:
Preparedness: Monitoring of Phenomena Triggering ADisasteror Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT - IV

Risk Assessment Disaster Risk:
Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. TechniquesofRiskAssessment,GlobalCo-OperationinRiskAssessmentand Warning, People’s Participation in Risk Assessment. Strategies for Survival.

UNIT - V

Disaster Mitigation:
Meaning,ConceptandStrategiesofDisasterMitigation,EmergingTrendsInMitigation.Structural Mitigationand Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Suggested Reading

1. R.Nishith,SinghAK,"DisasterManagementinIndia:Perspectives,issuesandstrategies
2. "'New Royal book Company..Sahni,PardeepEt.Al.(Eds.),"DisasterMitigationExperiencesAndReflections",PrenticeHall OfIndia, New Delhi.
3. GoelS.L.,DisasterAdministrationAndManagementTextAndCaseStudies",Deep&Deep Publication Pvt. Ltd., New Delhi

M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	SANSKRITFOR TECHNICAL KNOWLEDGE	L	T	P	C
21DAC101c		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- LearningofSanskrittodevelopthelogicinmathematics,science&othersubjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge
- Knowledge from ancientliterature

Course Outcomes (CO): Student will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science &technology can be understood
- Being a logical language will help to develop logic in students

UNIT - I

Alphabets in Sanskrit,

UNIT - II

Past/Present/Future Tense, Simple Sentences

UNIT - III

Order, Introduction of roots

UNIT - IV

Technical information about Sanskrit Literature

UNIT - V

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Suggested Reading

1.“Abhyaspustakam” –Dr.Vishwas, Sanskrit-Bharti Publication, New Delhi
2.“Teach Yourself Sanskrit” Prathama Deeksha- VempatiKutumbshastri, RashtriyaSanskrit Sansthanam, New Delhi Publication
3.“India’s Glorious ScientificTradition” Suresh Soni, Ocean books (P) Ltd.,New Delhi

AUDIT COURSE-II

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	PEDAGOGY STUDIES	L	T	P	C
21DAC201a		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

- Reviewexistingevidenceonthereviewtopictoinformprogrammedesignandpolicy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes (CO): Student will be able to

Students will be able to understand:

- Whatpedagogicalpracticesarebeingusedbyteachersinformalandinformalclassrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- Howcanteachereducation(curriculumandpracticum)andtheschoolcurriculumand guidance materials best support effective pedagogy?

UNIT - I

Introduction and Methodology: Aims and rationale, Policy back ground, Conceptual frame work and terminology Theories oflearning,Curriculum,Teachereducation.Conceptualframework,Research questions**.** Overview of methodology and Searching.

UNIT - II

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT - III

Evidence on theeffectivenessofpedagogicalpractices,Methodologyfortheindepthstage:quality assessmen t of included studies. How can teacher education (curriculumandpracticum) andthescho curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of th body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT - IV

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacherandthecommunity.Curriculumandassessment,Barrierstolearning:limitedresourcesand large class sizes

UNIT - V

Researchgapsandfuturedirections: Researchdesign**,**Contexts**,**Pedagogy**,**Teachereducation**,** Curriculum and assessment**,** Dissemination and research impact.

Suggested Reading

1. AckersJ,HardmanF(2001)ClassroominteractioninKenyanprimaryschools,Compare, 31 (2): 245-261.
2. AgrawalM(2004)Curricularreforminschools:Theimportanceofevaluation,Journalof

3. Curriculum Studies, 36 (3): 361-379.
4. AkyeampongK(2003) Teacher training in Ghana - does it count? Multi-site teachereducation research project (MUSTER) country report 1. London: DFID.
5. Akyeampong K, LussierK, PryorJ, Westbrook J (2013)Improving teaching and learning of basic maths and reading in Africa: Does teacherpreparation count?International Journal Educational Development, 33 (3): 272–282.
6. Alexander RJ(2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
   Chavan M (2003)ReadIndia: A mass scale, rapid, 'learning to read'campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	STRESSMANAGEMENT BY YOGA	L	T	P	C
21DAC201b		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

- To achieve overall health of body and mind
- To overcome stres

Course Outcomes (CO): Student will be able to

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT - I

Definitions of Eight parts of yog.(Ashtanga)

UNIT - II

Yam and Niyam.

UNIT - III

Do`sand Don't'sin life.

i) Ahinsa,satya,astheya,bramhacharyaand aparigrahaii) Shaucha,santosh,tapa,swadhyay,ishwarpranidhan

UNIT - IV

Asan and Pranayam

UNIT - V

i)Variousyogposesand theirbenefitsformind &body

ii)Regularizationofbreathingtechniques and its effects-Types ofpranayam

Suggested Reading

1.'Yogic Asanas forGroupTarining-Part-I": Janardan SwamiYogabhyasiMandal, Nagpur
2."Rajayogaor conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	PERSONALITY DEVELOPMENT THROUGHLIFE ENLIGHTENMENTSKILLS	L	T	P	C
21DAC201c		2	0	0	0
	Semester	II			

Course Objectives: This course will enable students:

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

Course Outcomes (CO): Student will be able to

- StudyofShrimad-Bhagwad-Geetawillhelpthestudentindevelopinghispersonalityand achieve the highest goal in life
- The person who has studied Geetawilllead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT - I

Neetisatakam- Holistic development of personality
Verses-19,20,21,22(wisdom)
Verses-29,31,32(pride &heroism)
Verses-26,28,63,65(virtue)

UNIT - II

Neetisatakam- Holistic development of personality
Verses-52,53,59(dont's)
Verses-71,73,75,78(do's)

UNIT - III

Approach to day to day work and duties.
ShrimadBhagwadGeeta:Chapter2-Verses41,47,48,
Chapter3-Verses13,21,27,35,Chapter6-Verses5,13,17,23,35,
Chapter18-Verses45,46,48.

UNIT - IV

Statements of basic knowledge.
ShrimadBhagwadGeeta:Chapter2-Verses 56,62,68
Chapter12 -Verses13,14,15,16,17,18
Personality of Rolemodel. Shrimad Bhagwad Geeta:

UNIT - V

Chapter2-Verses 17,Chapter3-Verses36,37,42,
Chapter4-Verses18,38,39
Chapter18– Verses37,38,63

Suggested Reading

1.“SrimadBhagavadGita”bySwamiSwarupanandaAdvaitaAshram(PublicationDepartment), Kolkata
2.Bhartrihari'sThree Satakam (Niti-sringar-vairagya) by P.Gopinath, RashtriyaSanskrit Sansthanam, New Delhi.

OPEN ELECTIVE

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING
COURSE STRUCTURE & SYLLABI

Course Code	INDUSTRIAL SAFETY	L	T	P	C
21DOE301b	(Common to M.Tech CSE, CN, SE,AI & ML)	3	0	0	3
	Semester	III			

Course Objectives:

- To know about Industrial safety programs and toxicology, Industrial laws , regulations and source models
- To understand about fire and explosion, preventive methods, relief and its sizing methods
- To analyse industrial hazards and its risk assessment.

Course Outcomes (CO): Student will be able to

- To list out important legislations related to health, Safety and Environment.
- To list out requirements mentioned in factories act for the prevention of accidents.
- To understand the health and welfare provisions given in factories act.

UNIT - I Lecture Hrs:

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT - II Lecture Hrs:

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT - III Lecture Hrs:

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working andapplications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT - IV Lecture Hrs:

Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT - V Lecture Hrs:

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Textbooks:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.

Reference Books:

1.Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
2. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

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M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	**BUSINESS ANALYTICS**	**L**	**T**	**P**	**C**
21DOE301c	**(Common to M.Tech CSE, CN, SE,AI & ML)**	**3**	**0**	**0**	**3**
	Semester		**III**		

Course Objectives:

- The main objective of this course is to give the student a comprehensive understanding of business analytics methods.

Course Outcomes (CO): Student will be able to

- Students will demonstrate knowledge of data analytics.
- Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
- Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
- Students will demonstrate the ability to translate data into clear, actionable insights.

UNIT - I Lecture Hrs:

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst. Stakeholders: the project team, management, and the front line, Handling Stakeholder Conflicts.

UNIT - II Lecture Hrs:

Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

UNIT - III Lecture Hrs:

Forming Requirements: Overview of Requirements, Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents. Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

UNIT - IV Lecture Hrs:

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements. Managing Requirements Assets: Change Control, Requirements Tools

UNIT - V Lecture Hrs:

Recent Trands in: Embedded and colleborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

Textbooks:

1. Business Analysis by James Cadle et al.
2. Project Management: The Managerial Process by Erik Larson and, Clifford Gray

Reference Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
(Established by Govt. of A.P., ACT No.30 of 2008)
ANANTHAPURAMU – 515 002 (A.P) INDIA

M.TECH. IN COMPUTER SCIENCE AND ENGINEERING

COURSE STRUCTURE & SYLLABI

Course Code	OPTIMIZATION TECHNIQUES	L	T	P	C
21DOE301f	(Common to M.Tech CSE, CN, SE,AI & ML)	3	0	0	3
	Semester	III			

Course Objectives:

- Enumerate the fundamental knowledge of Linear Programming and Dynamic Programming problems.
- Learn classical optimization techniques and numerical methods of optimization.
- Know the basics of different evolutionary algorithms.
- Explain Integer programming techniques and apply different optimization techniques to solve various models arising from engineering areas.

Course Outcomes (CO): Student will be able to

- Explain the fundamental knowledge of Linear Programming and Dynamic Programming problems.
- Use classical optimization techniques and numerical methods of optimization.
- Describe the basics of different evolutionary algorithms.
- Enumerate fundamentals of Integer programming technique and apply different techniques to solve various optimization problems arising from engineering areas

UNIT - I Lecture Hrs:

LINER PROGRAMMING (L.P):
Revised Simplex Method, Duel simplex Method, Sensitivity Analysis
DYNAMIC PROGRAMMING (D.P):
Multistage decision processes. Concepts of sub optimization, Recursive Relation-calculus method, tabular method, LP as a case of D.P.

UNIT - II Lecture Hrs:

CLASSICAL OPTIMIZATION TECHNIQUES:
Single variable optimization without constraints, Multi variable optimization without constraints, multivariable optimization with constraints – method of Lagrange multipliers, Kuhn-Tucker conditions.
NUMERICAL METHODS FOR OPTIMIZATION:
Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method

UNIT - III Lecture Hrs:

MODERN METHODS OF OPTIMIZATION:
GENETIC ALGORITHM (GA):
Differences and similarities between conventional and evolutionary algorithms, working principle, Genetic Operators- reproduction, crossover, mutation
GENETIC PROGRAMMING (GP):
Principles of genetic programming, terminal sets, functional sets, differences between GA &GP, Random population generation. Fuzzy Systems: Fuzzy set Theory, Optimization of Fuzzy systems

UNIT - IV Lecture Hrs:

INTEGER PROGRAMMING:
Graphical Representation, Gomory's Cutting Plane Method,Balas' Algorithm for Zero–One Programming, Branch-and-Bound Method

UNIT - V Lecture Hrs:

APPLICATIONS OF OPTIMIZATION IN DESIGN AND MANUFACTURING SYSTEMS:
Formulation of model- optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

Textbooks:

1. Engineering Optimization (4th Edition) by S.S.Rao, New Age International,

Reference Books:
1. Optimization for Engineering Design by Kalyanmoy Deb, PHI Publishers 2. Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers 3. Operations Research by Hillar and Liberman, TMH Publishers 4. Optimal design – JasbirArora, McGraw Hill (International) Publisher